



EVALUATION OF ESTROUS  
SYNCHRONIZATION  
PROGRAMS IN BEEF HEIFERS  
AND ASSESSMENT OF VALUE  
OF GENETIC SELECTION  
THROUGH ARTIFICIAL  
INSEMINATION

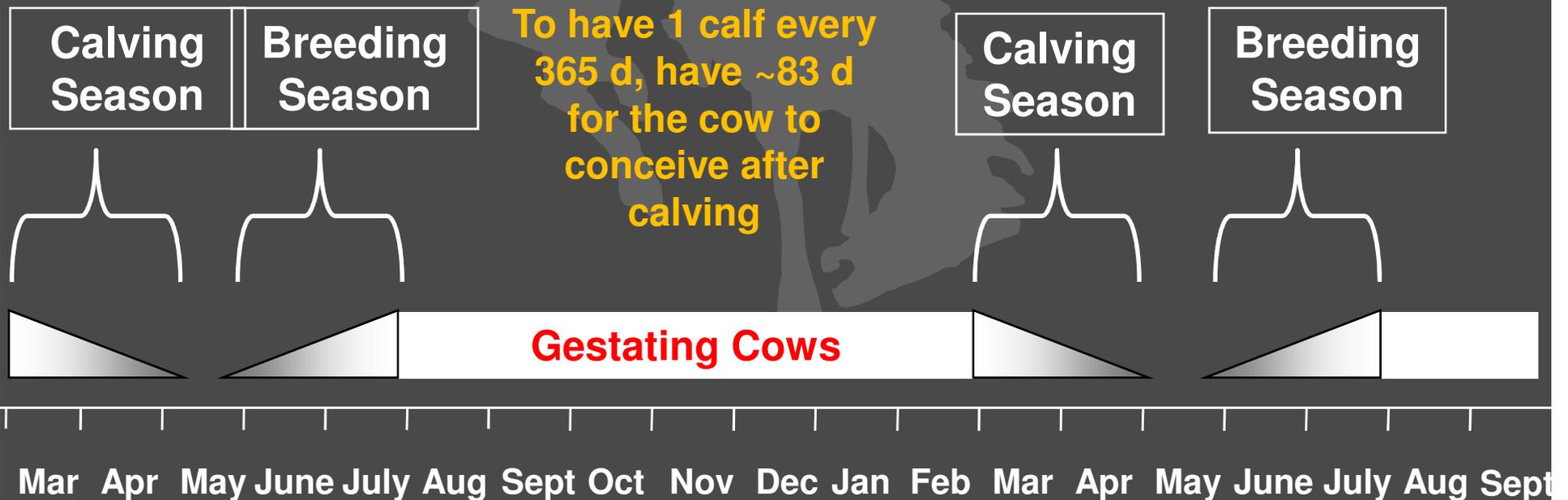
Scott Lake, University of Wyoming

# Why reproductive efficiency is so critical

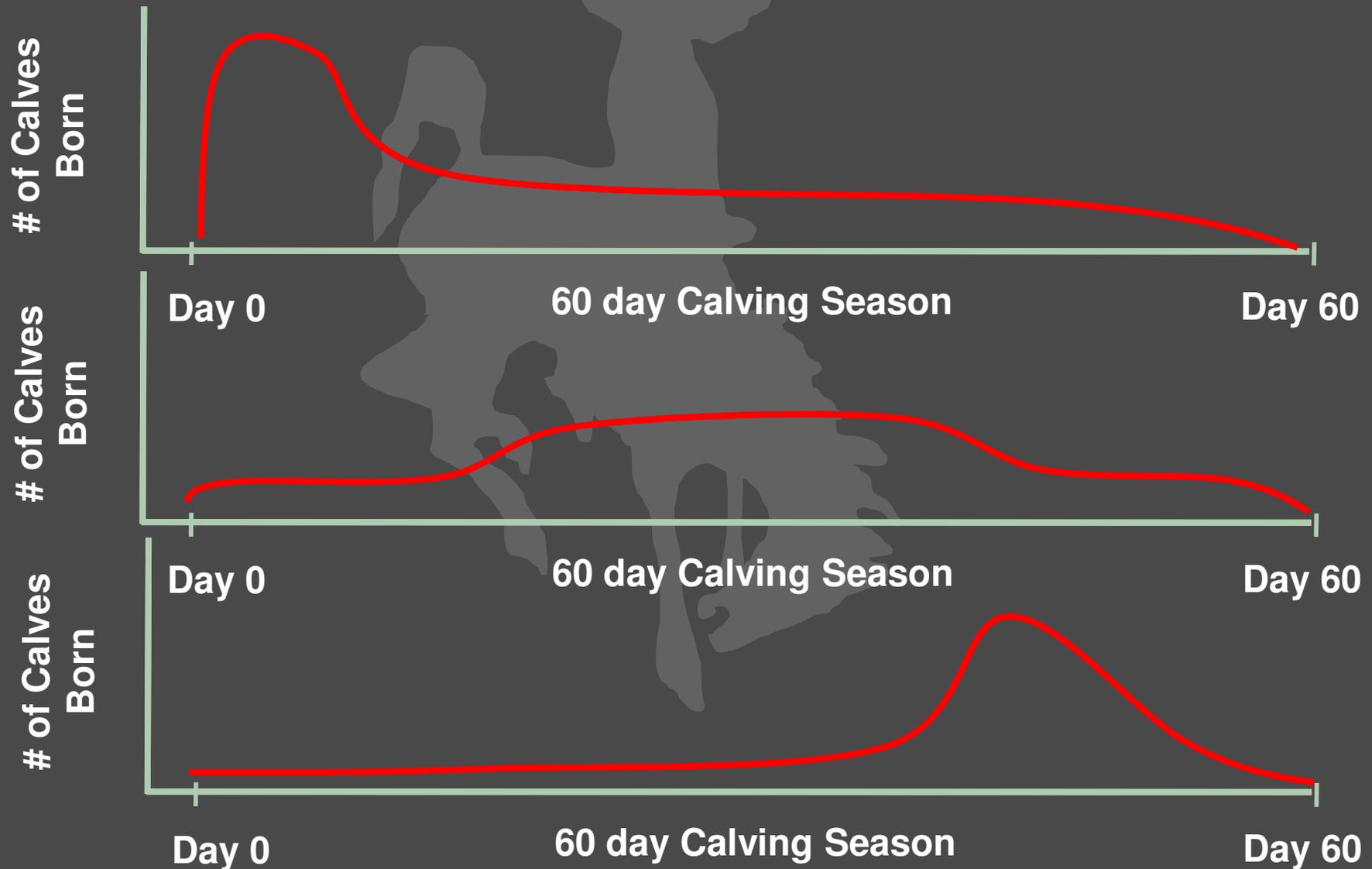
- 1% improvement in reproductive performance will generate up to a 3 fold greater return on investment than a one percent improvement in growth and/or product performance.
- 5x more important than product quality
- 5x more important than growth

# Reproductive goals for a cow/calf producer

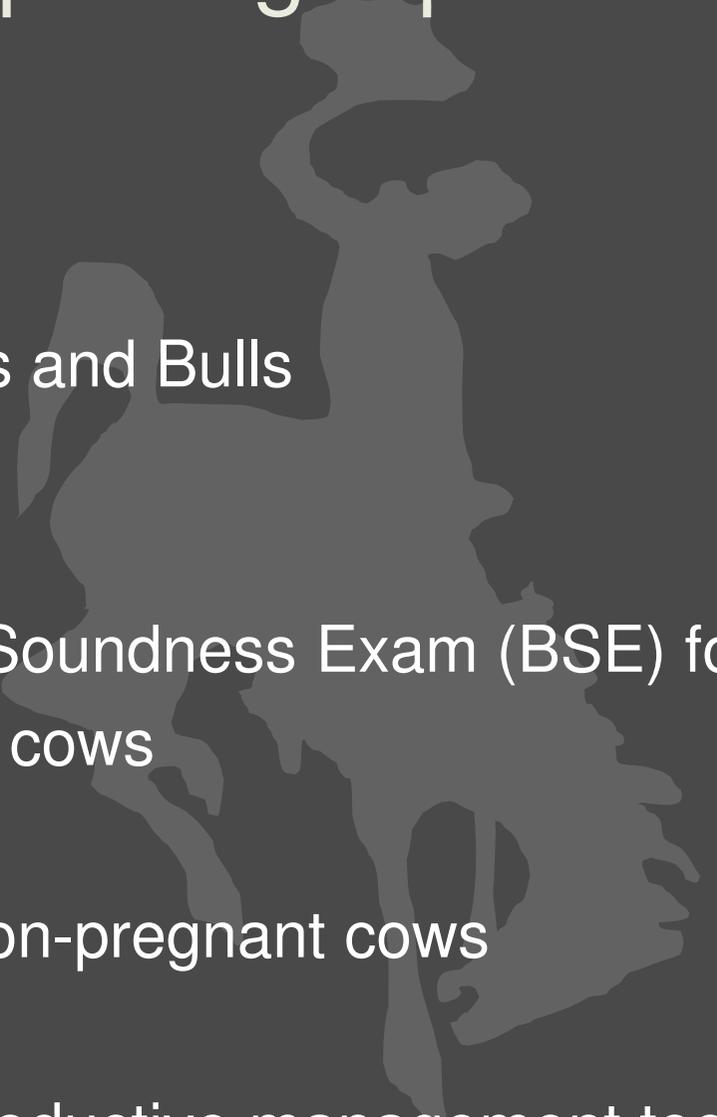
1. > 90% of cows wean a calf each year
2. Each cow produces a calf every 365 days



# Calving distribution



# Factors impacting reproductive efficiency

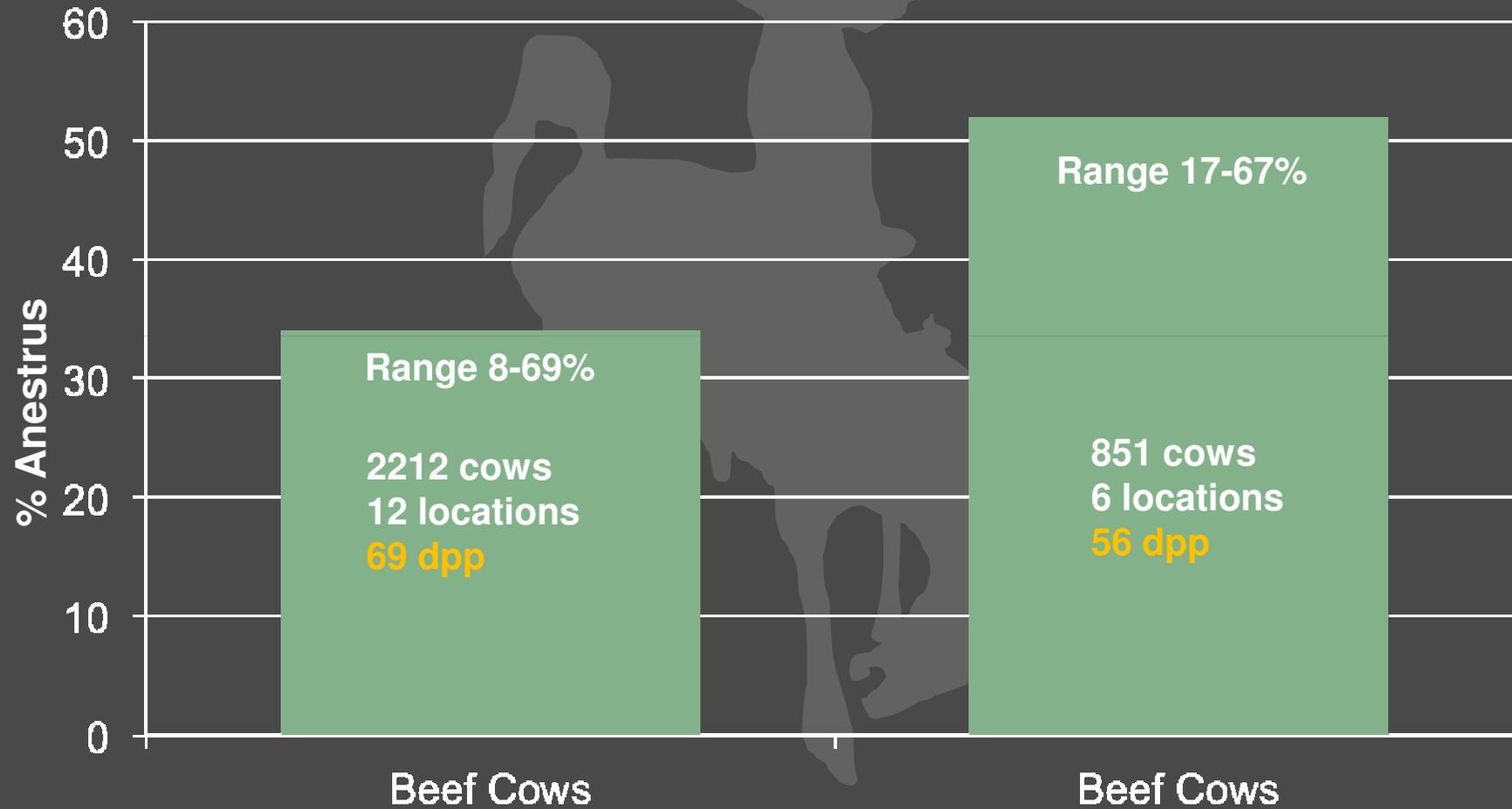
A faint, light-colored silhouette of a cow and a bull is visible in the background of the slide, positioned behind the text.

- Nutrition
  - Both Cows and Bulls
  
- Fertility
  - Breeding Soundness Exam (BSE) for bulls
  - Anestrous cows
  
- Identifying non-pregnant cows
  
- Utilizing reproductive management tools

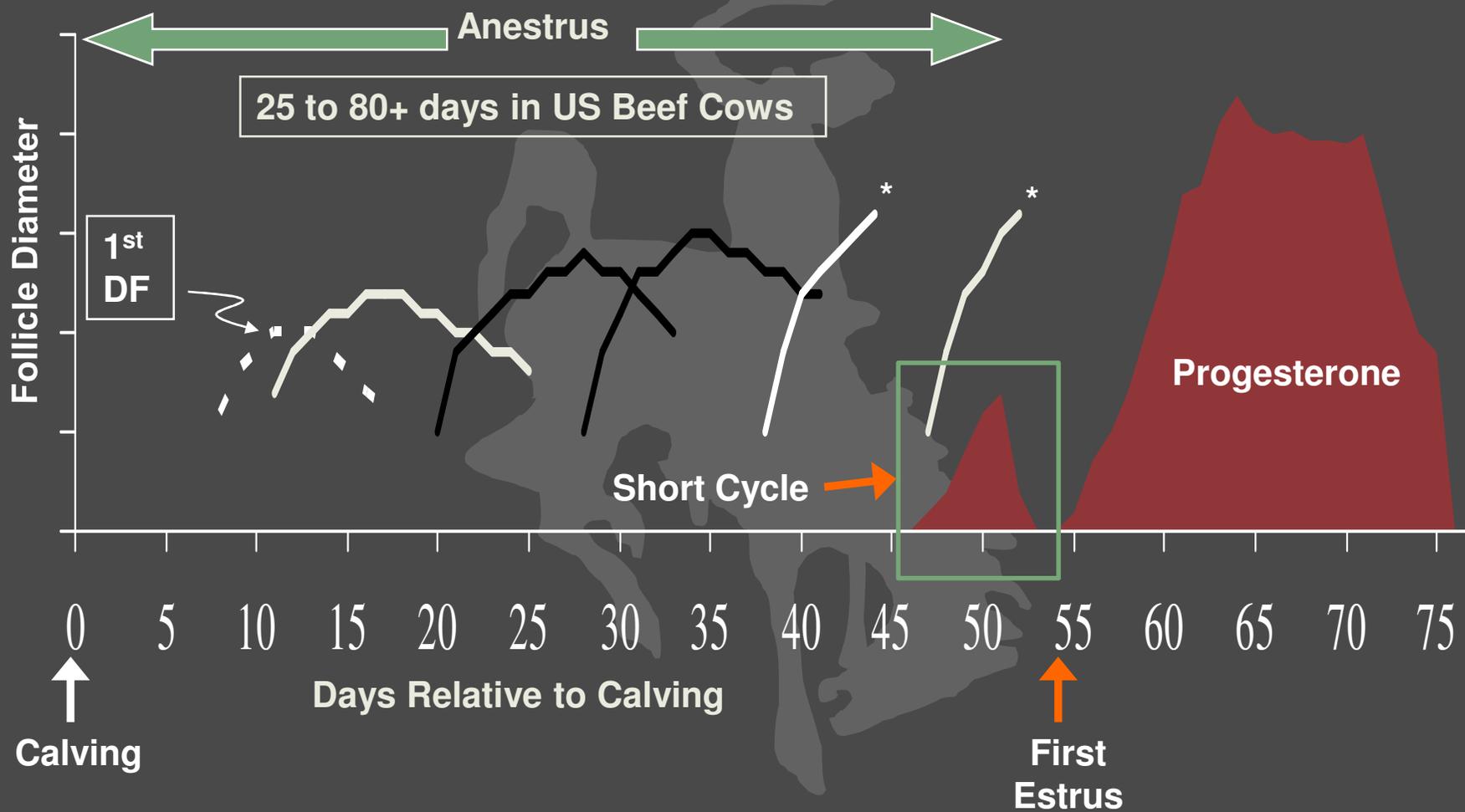
# Factors impacting cow fertility

- #1 factor in most herds: **PROPORTION OF ANESTROUS (non-cycling) COWS**
  - After calving, cows require a period of time for the uterus to heal (uterine involution) and for normal estrous cycles to resume, during this period they are termed “**Anestrus**”
  - The period from calving until the resumption of estrous cycles is the **postpartum interval**
  - Cows will not get pregnant until they resume estrous cycles

# Anestrus in US beef cattle at start of synchronization



# Postpartum anestrus in beef cows





# Calving date and % failing to calve in the subsequent year

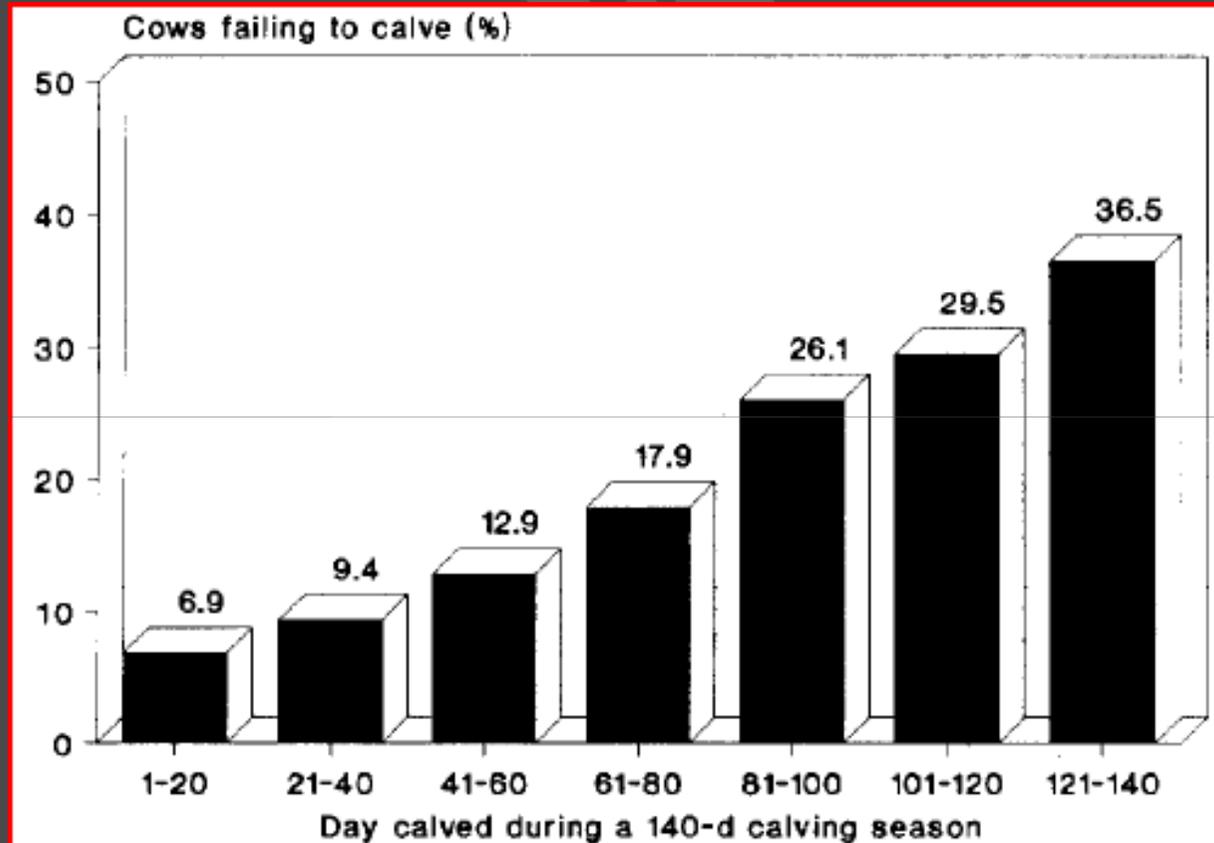


Figure 3. Effect of calving date on the number of cows calving the following year (adapted from Burriss and Priode, 1958).

# Why producers do **NOT** synchronize estrus

- **#1 Reason:** Time and Labor involved with detecting cows in estrus and having to individually handling cows that have exhibited estrus
- **SOLUTION: **TIMED-AI****
  - Allows every cow to be inseminated at a predetermined time
  - Does not require estrus detection
  - Females are handled in groups rather than individually

# Requirements for a successful timed-AI program

- Adequate animal handling and working facilities
  - Minimize handling stress
- Proper nutritional management
  - BCS at calving (5-5.5), start of breeding season (min. 5)
- Advanced planning and preparation
- Appropriate expectations

Slow down.....



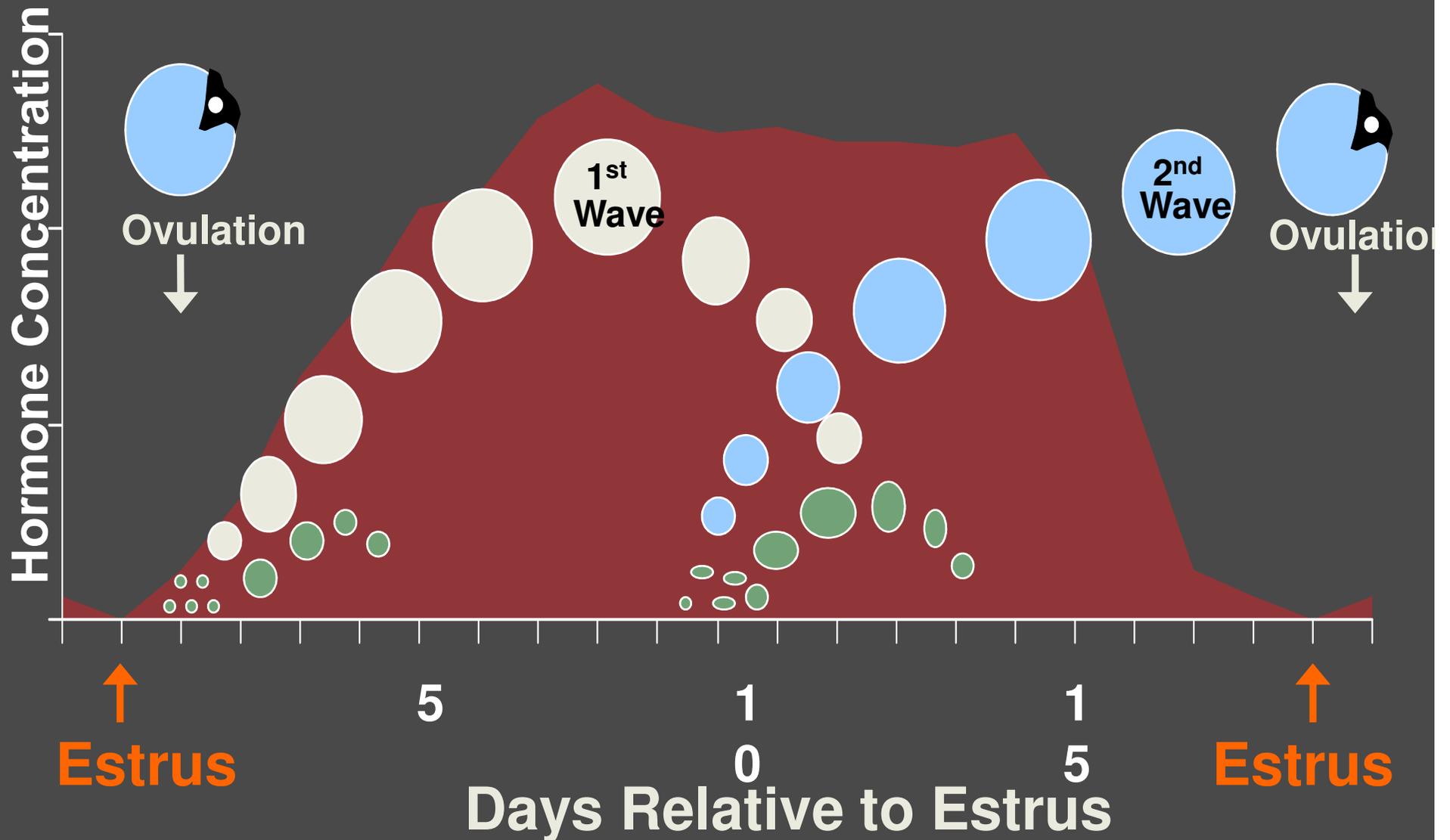
# Principles of a timed-AI program



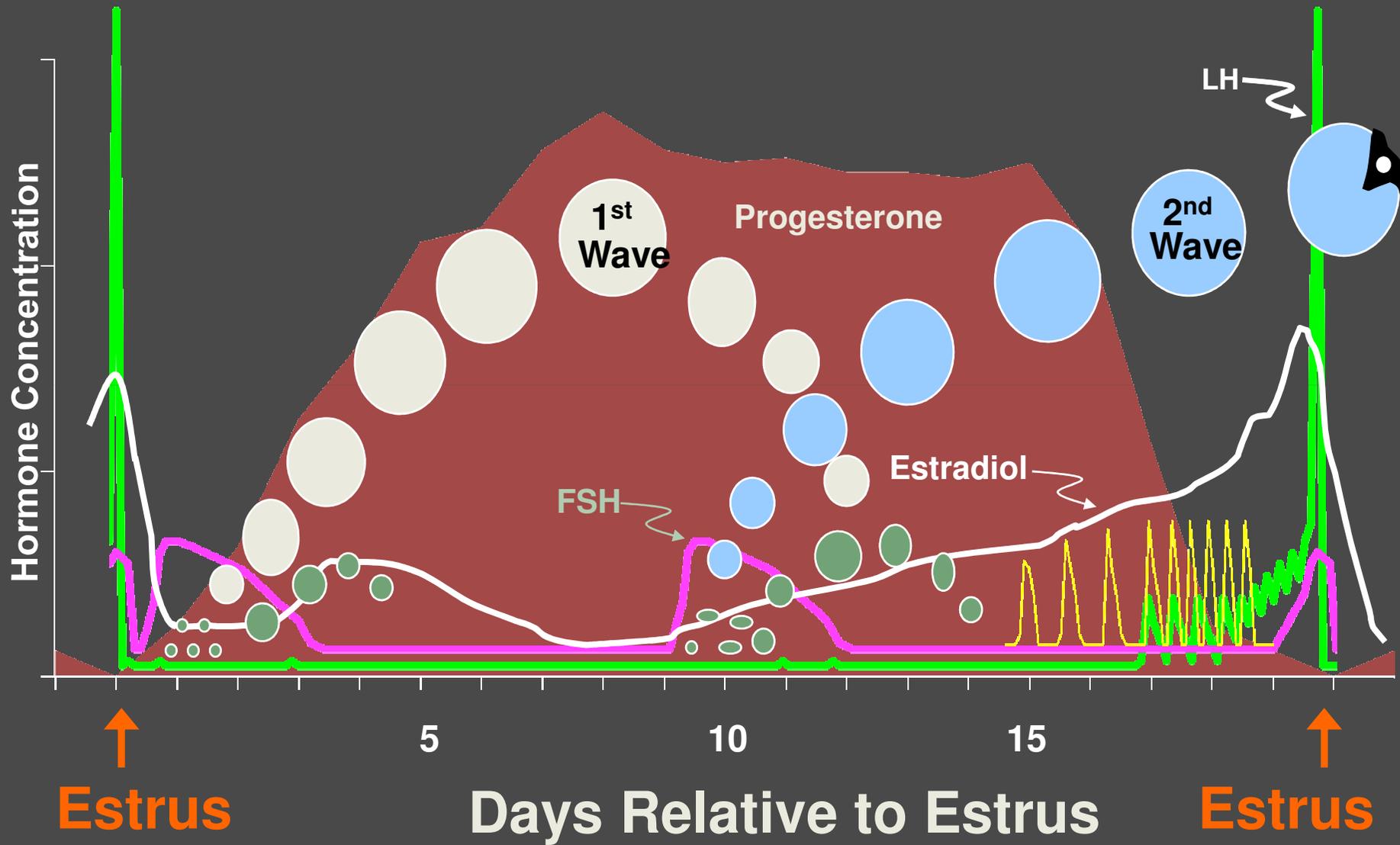
# Principles of a timed-AI program

1. Ability to control follicular wave dynamics
2. Control the lifespan of the CL
3. Induce a “mature” follicle to ovulate

# Waves of Follicular Development During the Cycle



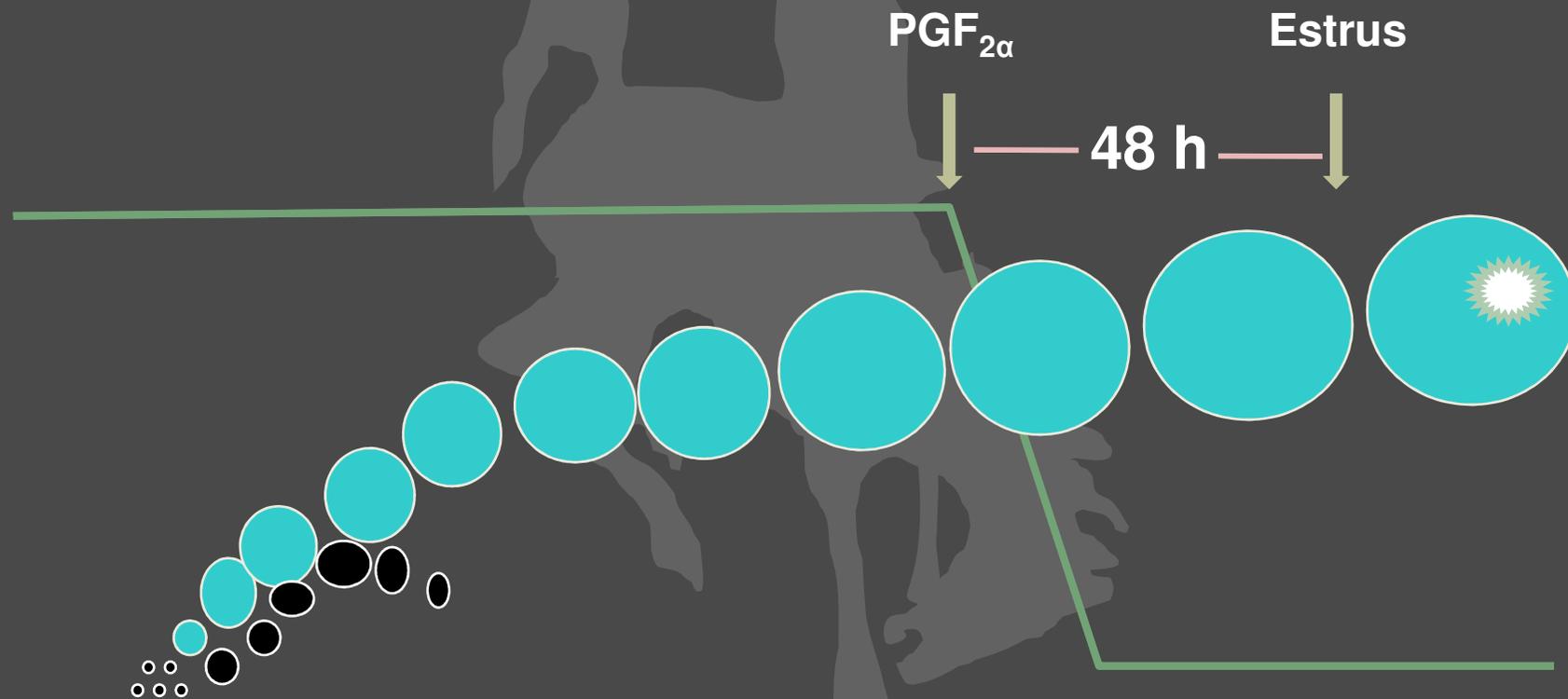
# The Estrous Cycle in Cattle





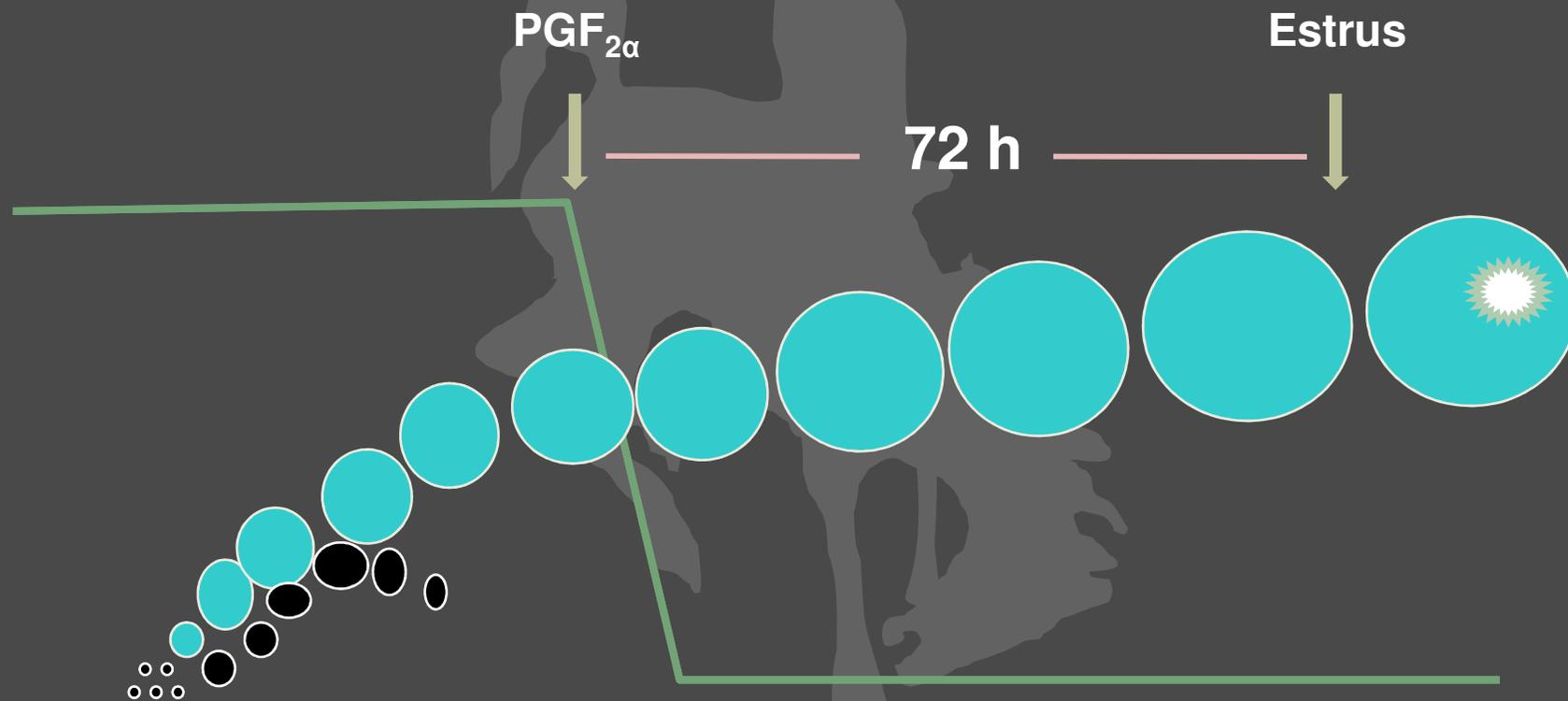
# Basic principles of a timed-AI program

1. Ability to control follicular wave dynamics



# Basic principles of a timed-AI program

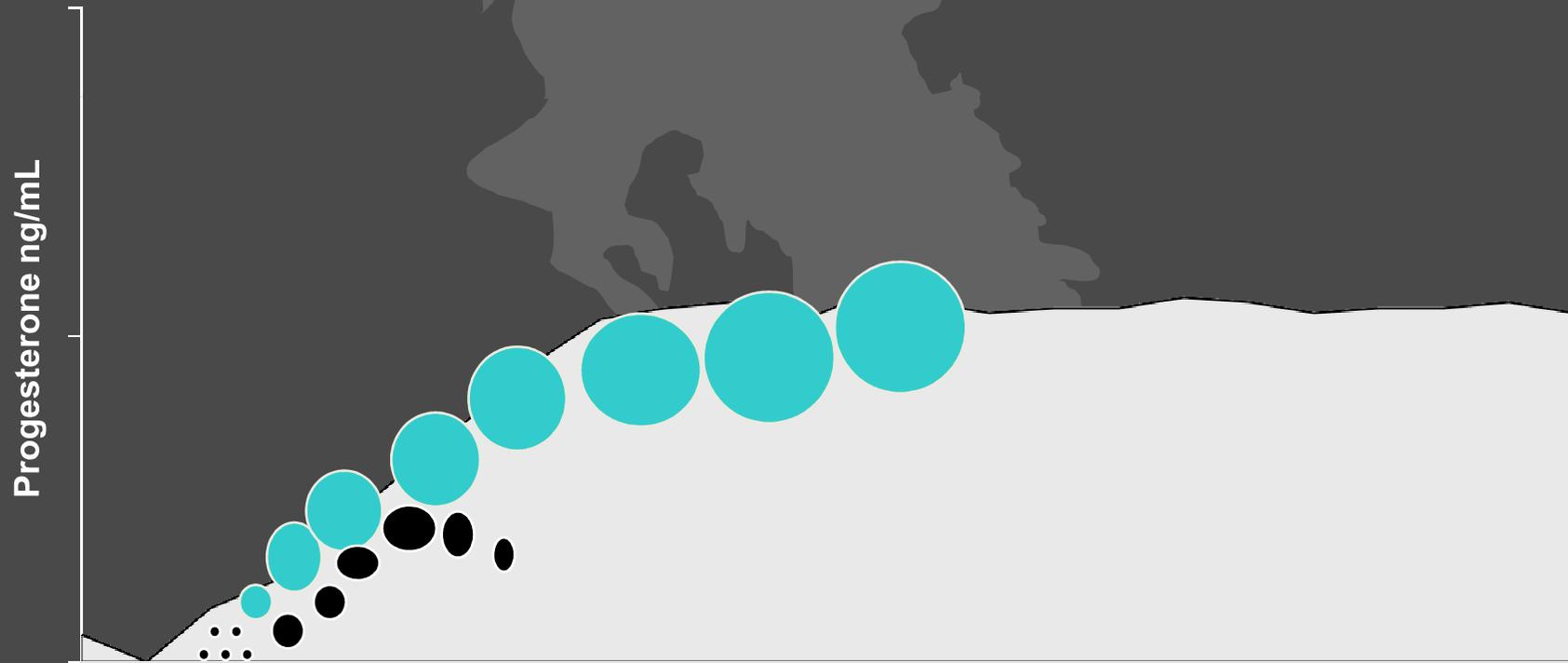
1. Ability to control follicular wave dynamics



**Without synchronizing follicle wave dynamics, developing a program to tightly synchronize estrus in all cows is challenging**

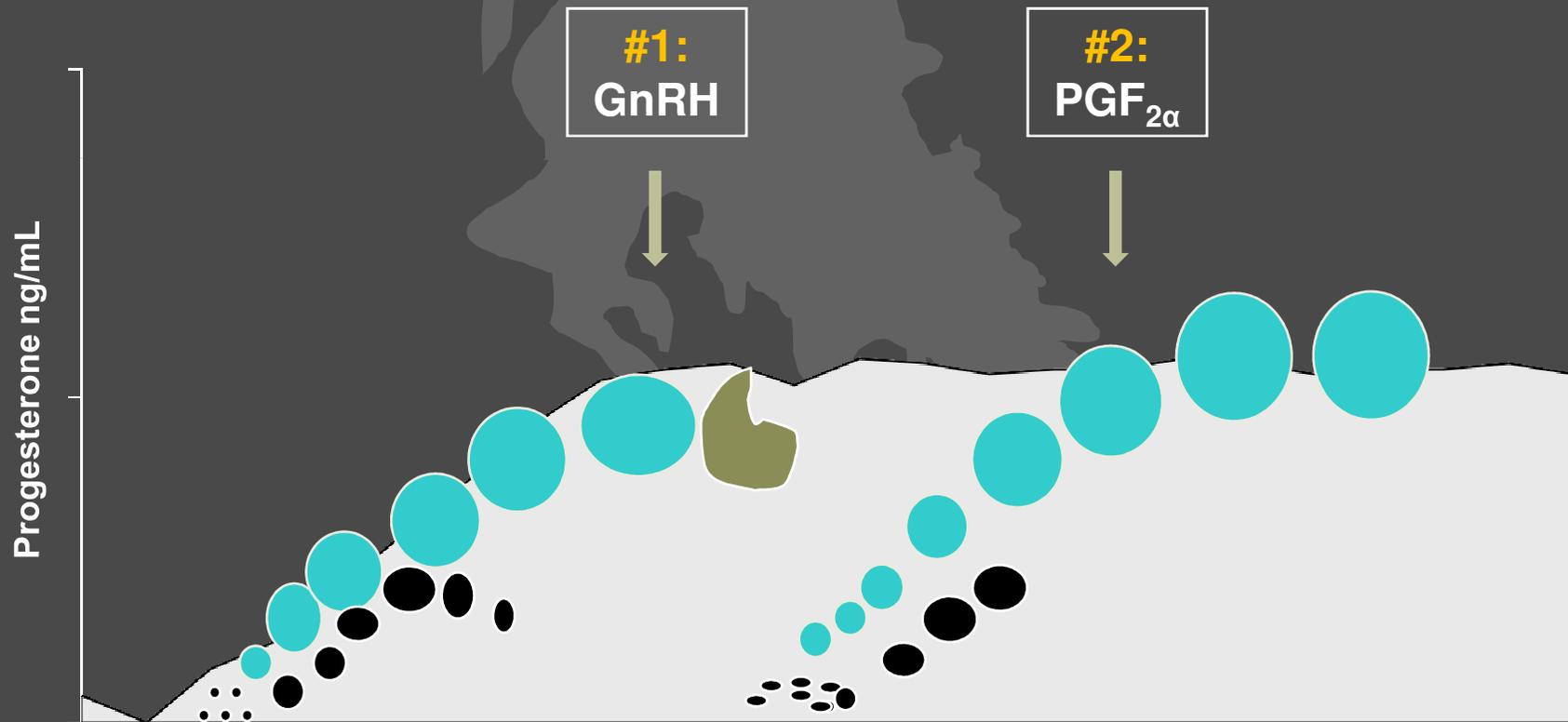
# Basic principles of a timed-AI program

1. Ability to control follicular wave dynamics

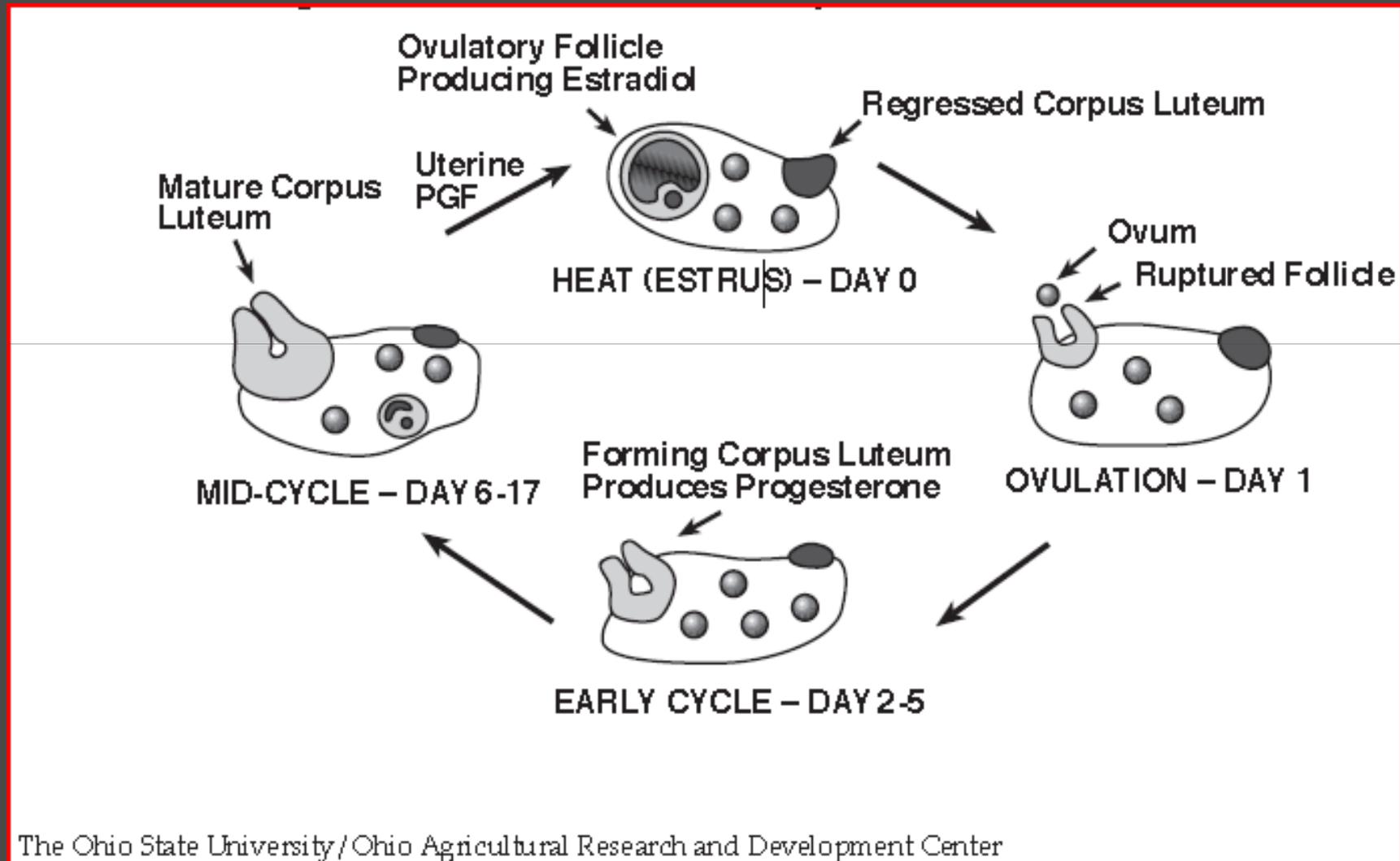


# Principles of a timed-AI program

1. Ability to control follicular wave dynamics
2. Control the lifespan of the CL

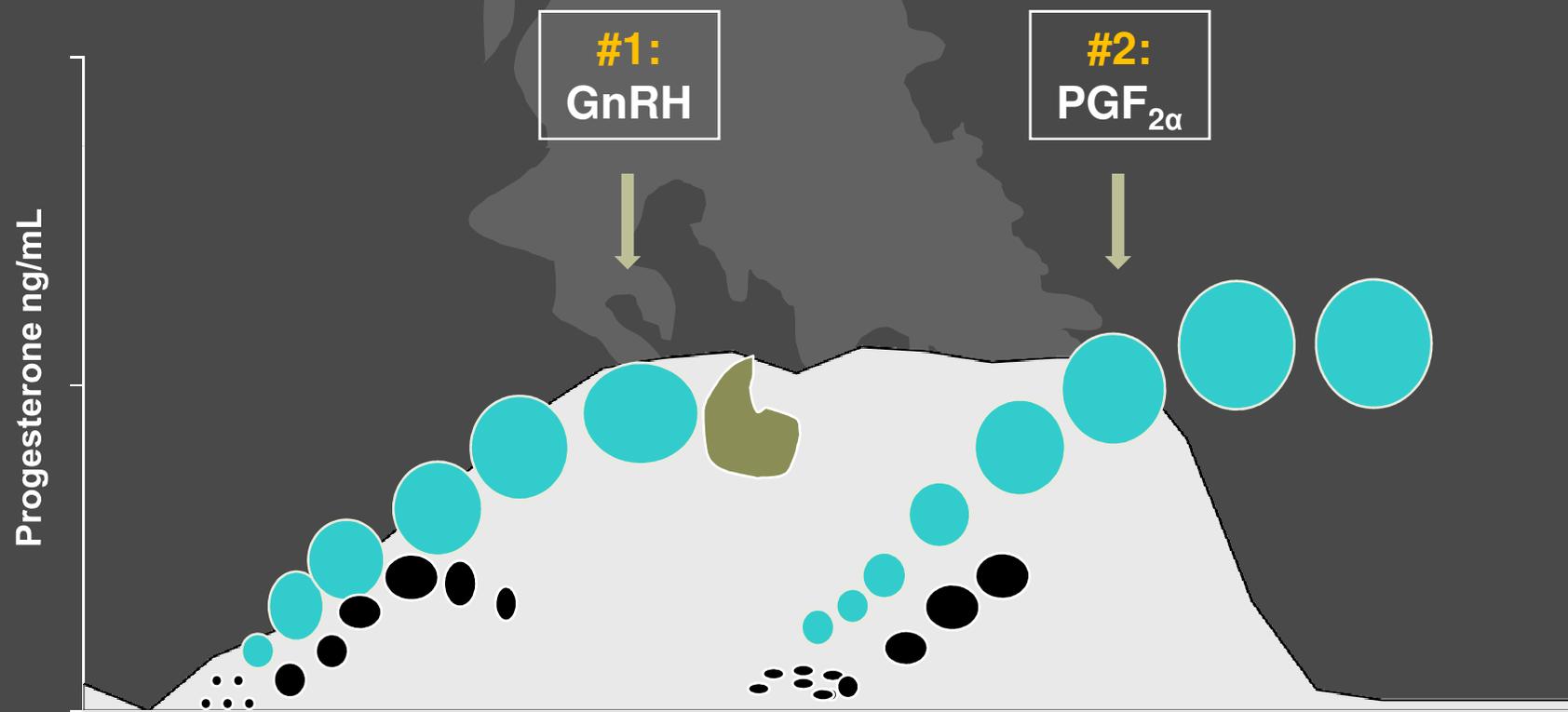


# Ovarian function in cattle



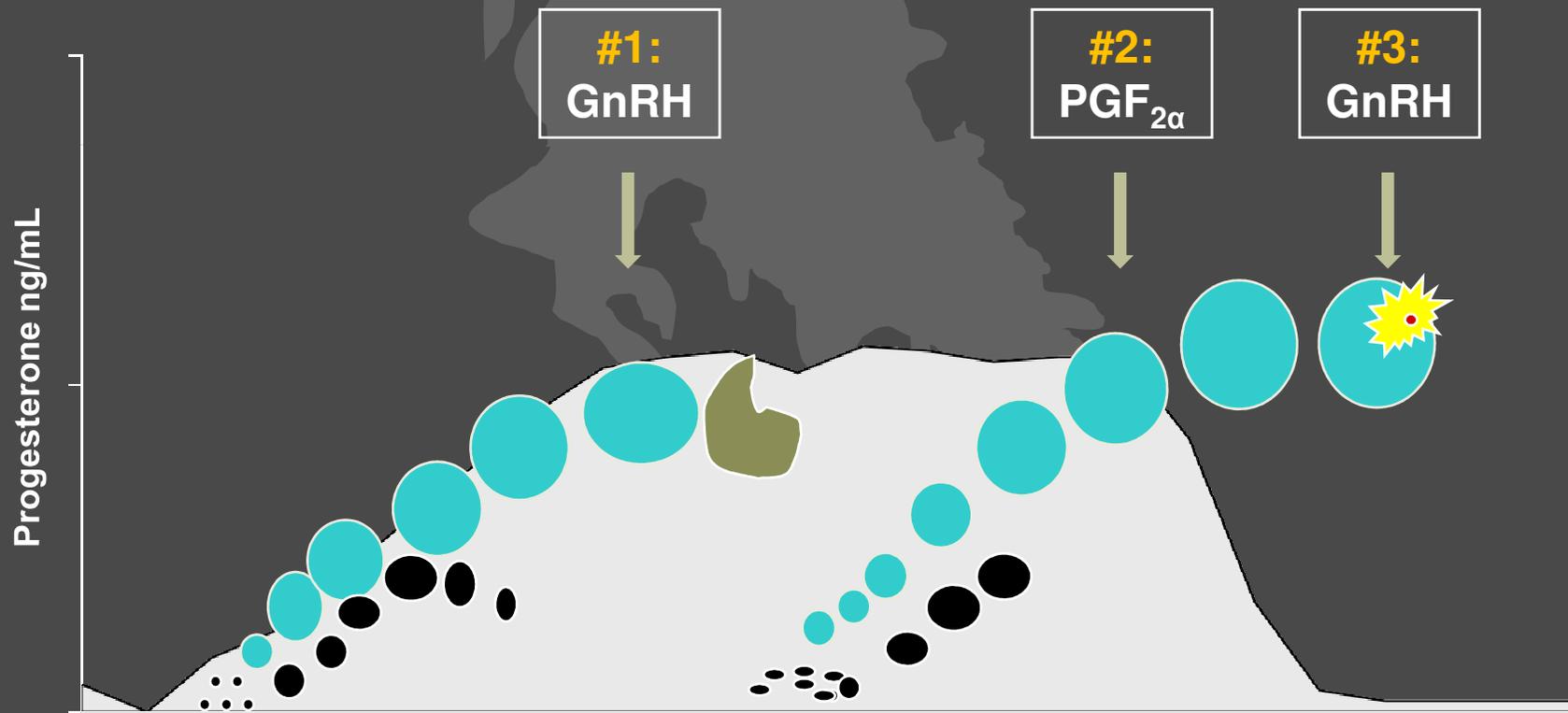
# Principles of a timed-AI program

1. Ability to control follicular wave dynamics
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# Principles of a timed-AI program

1. Ability to control follicular wave dynamics
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3. Induce a “mature” follicle to ovulate

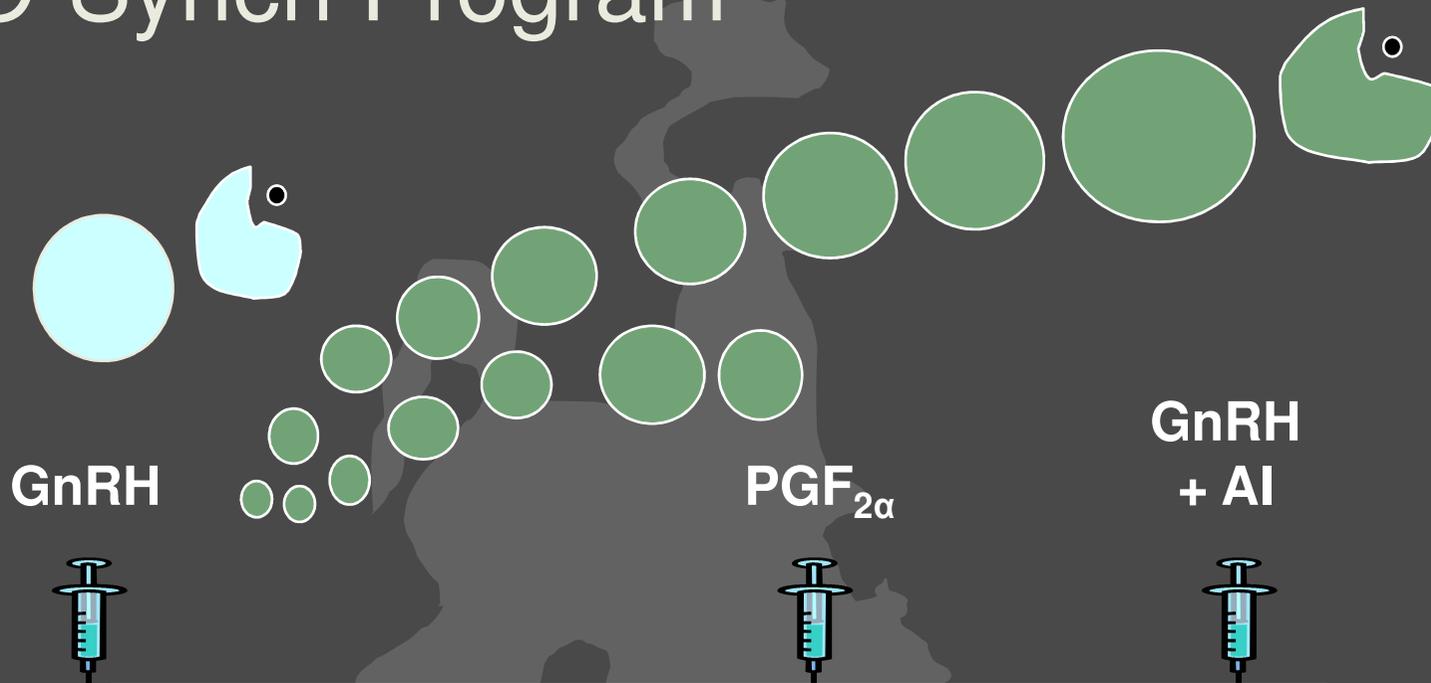


# Principles of a timed-AI program

1. Ability to control follicular wave dynamics
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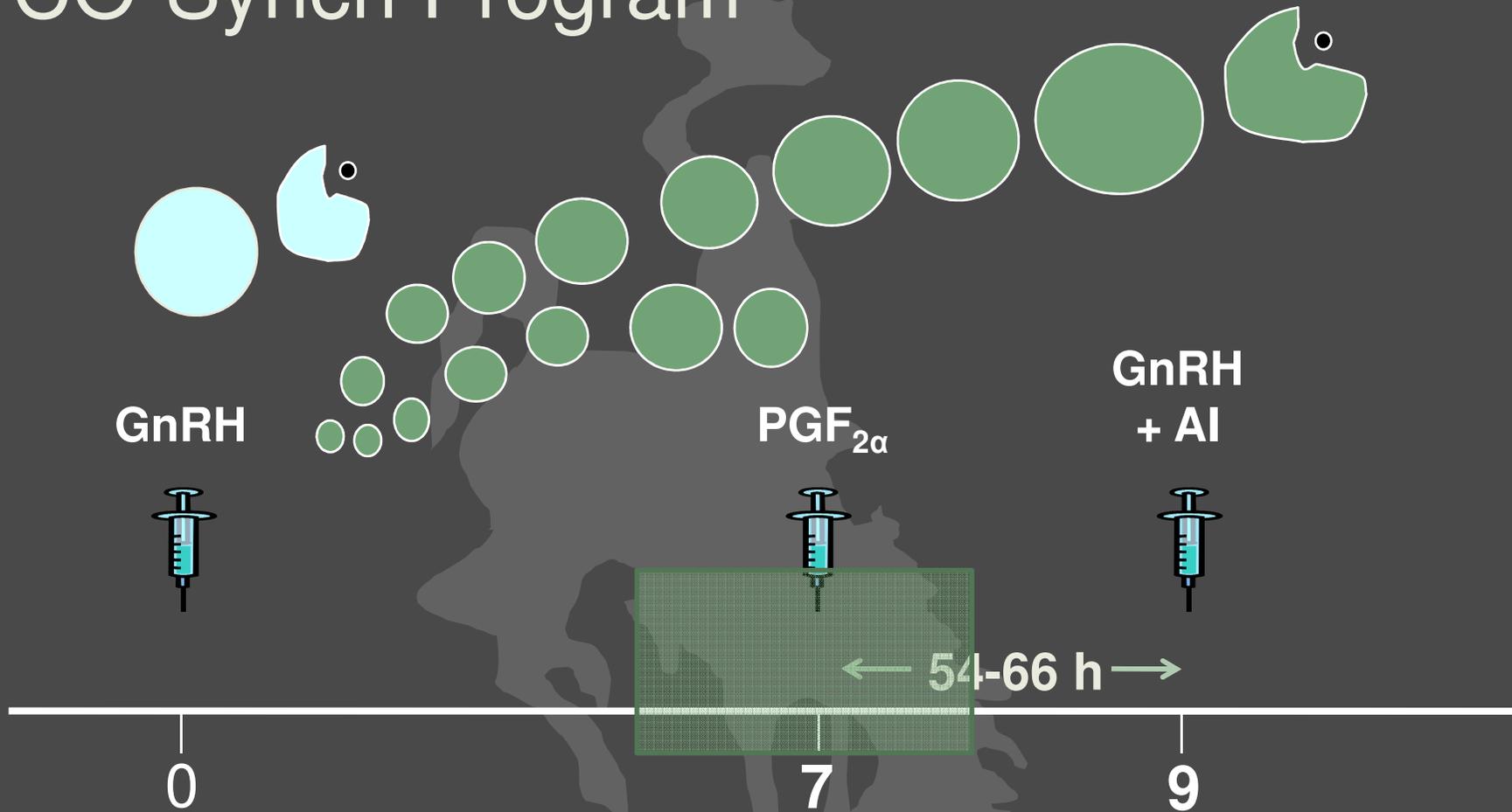


# CO-Synch Program



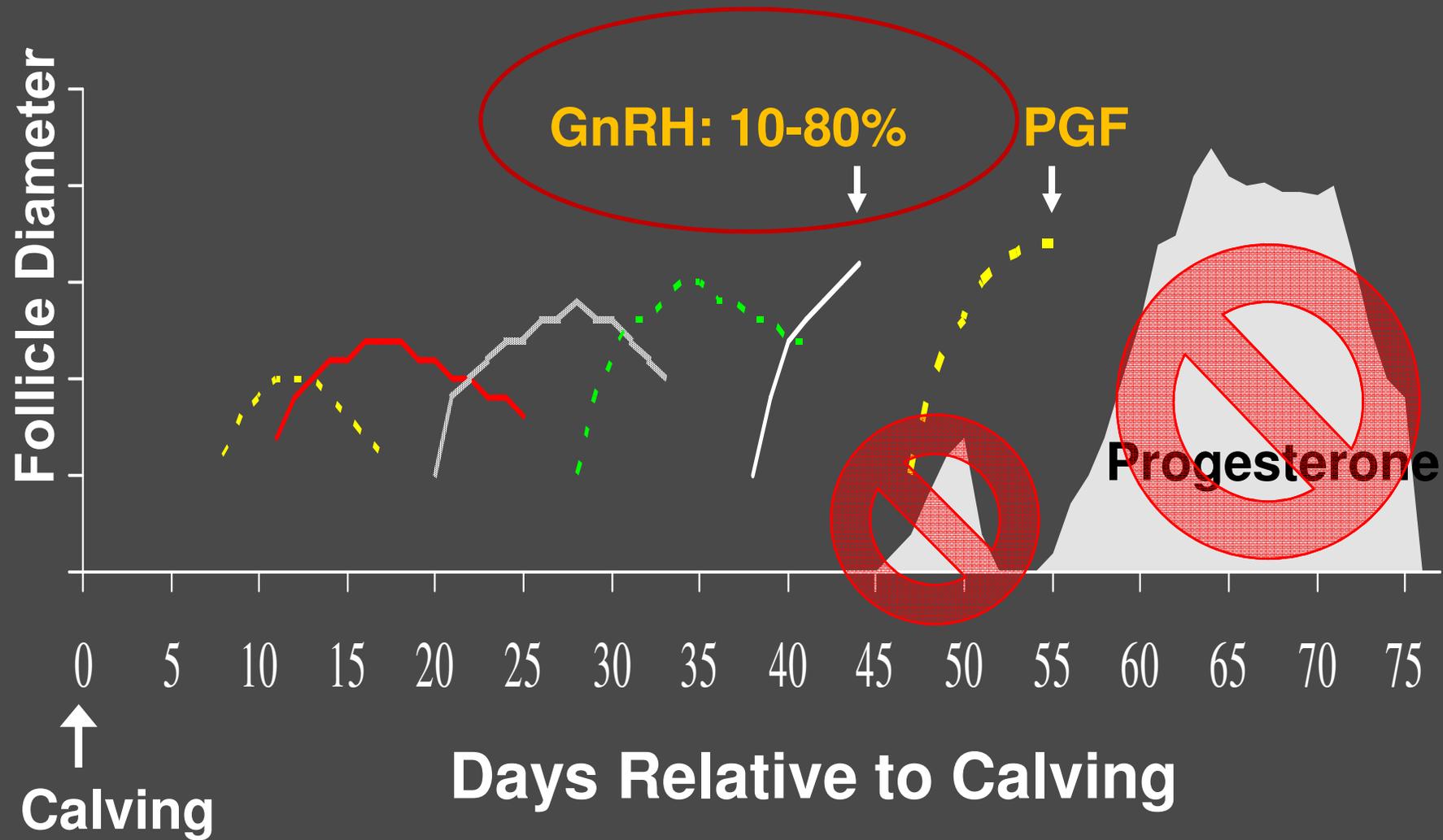
	# cows	% Preg to Timed-AI	Reference
0	548	43%	Larson et al. 2006
	323	66%	Schafer et al. 2007
	<b>Total</b>		
	<b>871</b>	<b>52%</b>	

# CO-Synch Program

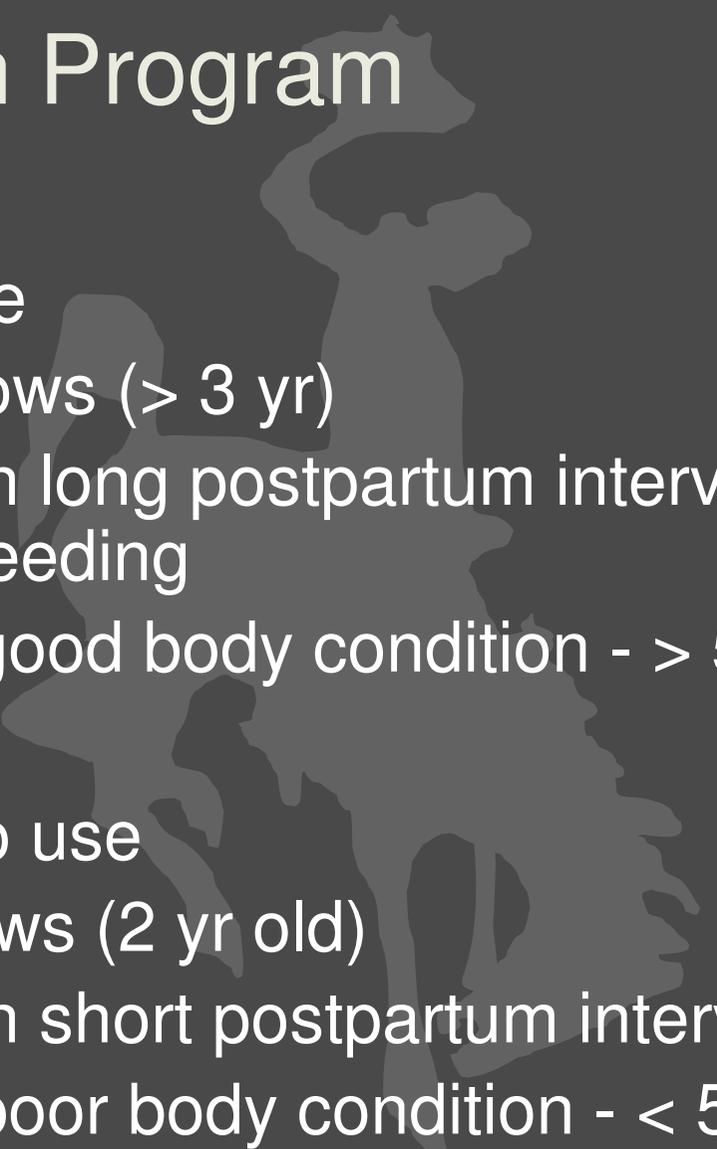


**10-20% of cows will  
prematurely exhibit estrus**

# Problems without exogenous progesterone



# CO-Synch Program



- When to use
  - Mature cows (> 3 yr)
  - Cows with long postpartum interval - > 60 days before breeding
  - Cows in good body condition - > 5.5 BCS
  
- When not to use
  - Young cows (2 yr old)
  - Cows with short postpartum interval - < 60 days
  - Cows in poor body condition - < 5 BCS



# CO-Synch + CIDR Program



# cows	% Pregnant to Timed-AI	Reference
215	59	Busch et al., 2007
157	63	Dobbins et al., 2006
365	45	Kasimanickam et al., 2006
181	48	Stevenson et al., 2003
599	52	Kasimanickam et al., 2008
111	53	Bridges et al., 2007
539	54	Larson et al., 2006
201	56	Bridges et al., 2007
111	68	Bridges et al., 2007
170	55	Dobbins et al., 2006
219	64	Busch et al., 2007
<b>Total</b>		
<b>2868</b>	<b>54%</b>	

# CO-Synch + CIDR Program

- Advantages
  - Minimal animal handling
  - Induce estrous cycles in anestrus cows
  - Effective in cyclic and anestrus cows
- Disadvantages
  - Initial GnRH not always effective in resetting follicle waves
  - Increased cost of CIDR

# Improving the CO-Synch Approach



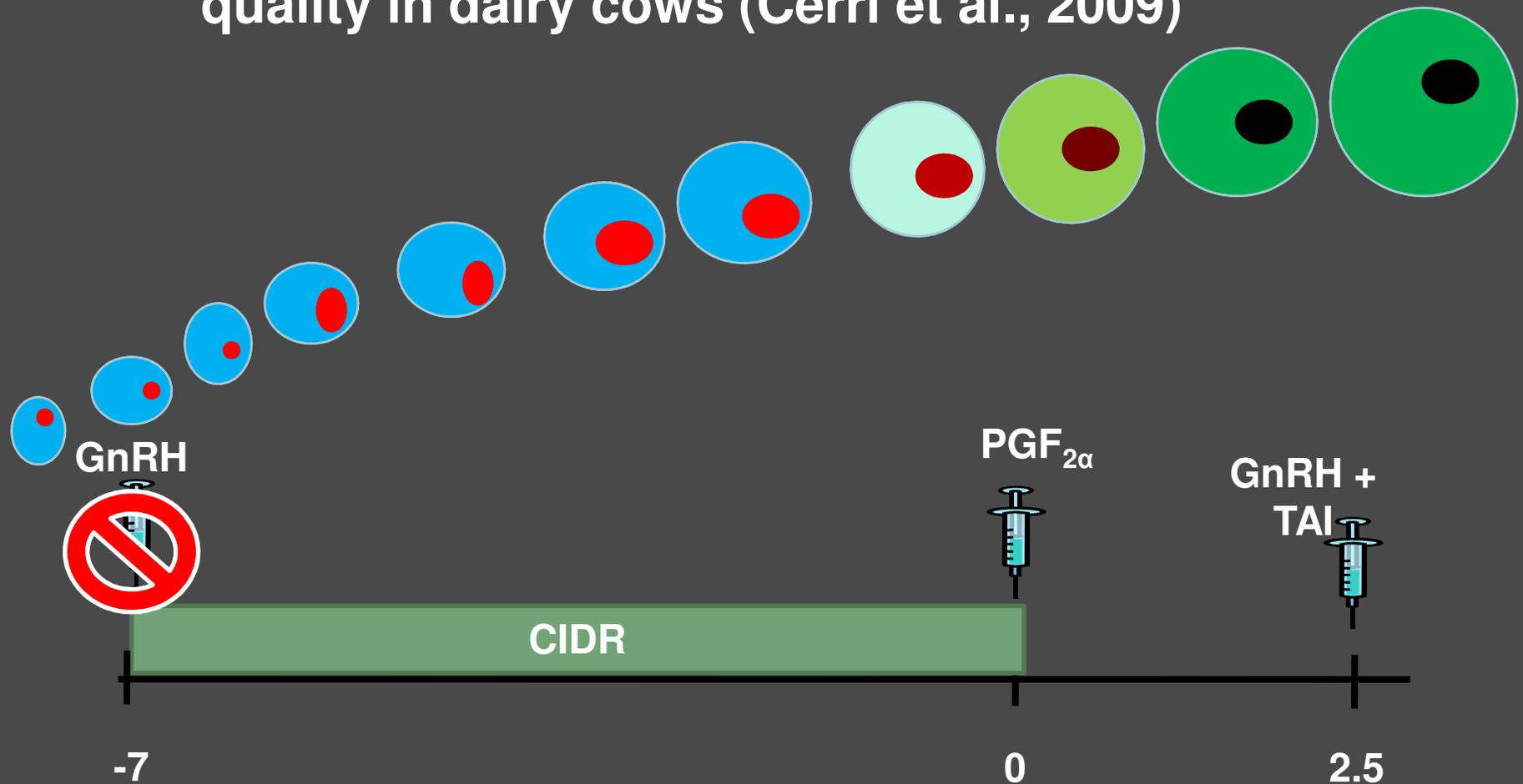
- It is evident that improvements to the CO-Synch program is needed
  - Handle animals that don't respond to GnRH
  - Increase estradiol concentrations prior to ovulation
  - Promote ovulation of follicle that has greatest probability in resulting in a pregnancy



# Failure of GnRH to turnover follicles

## Scenario #1: Ovulation of aged follicle

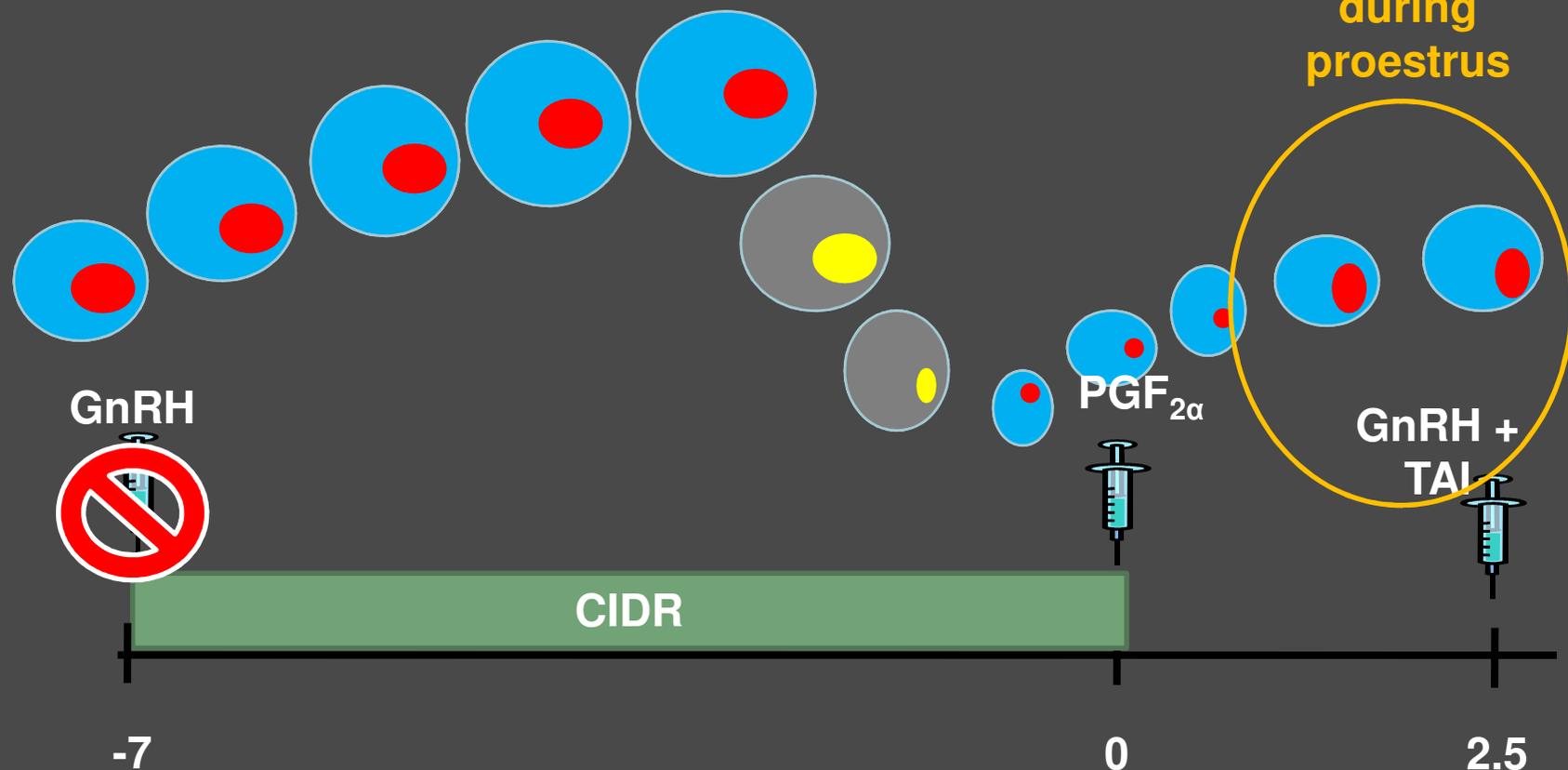
- Shown to result in reduced embryo quality in dairy cows (Cerri et al., 2009)



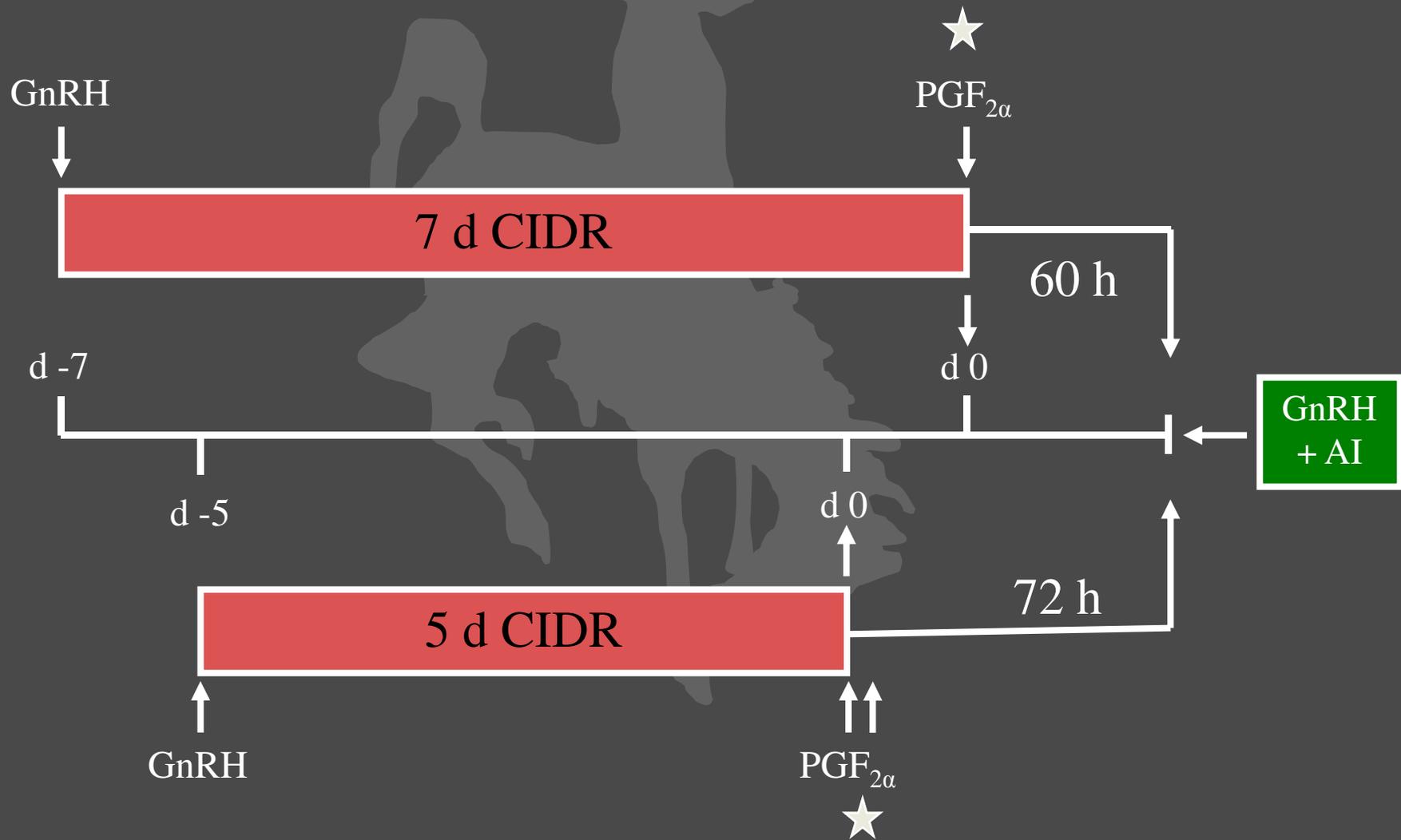
# Failure of GnRH to turnover follicles

## Scenario #2: Ovulation of "immature" follicle

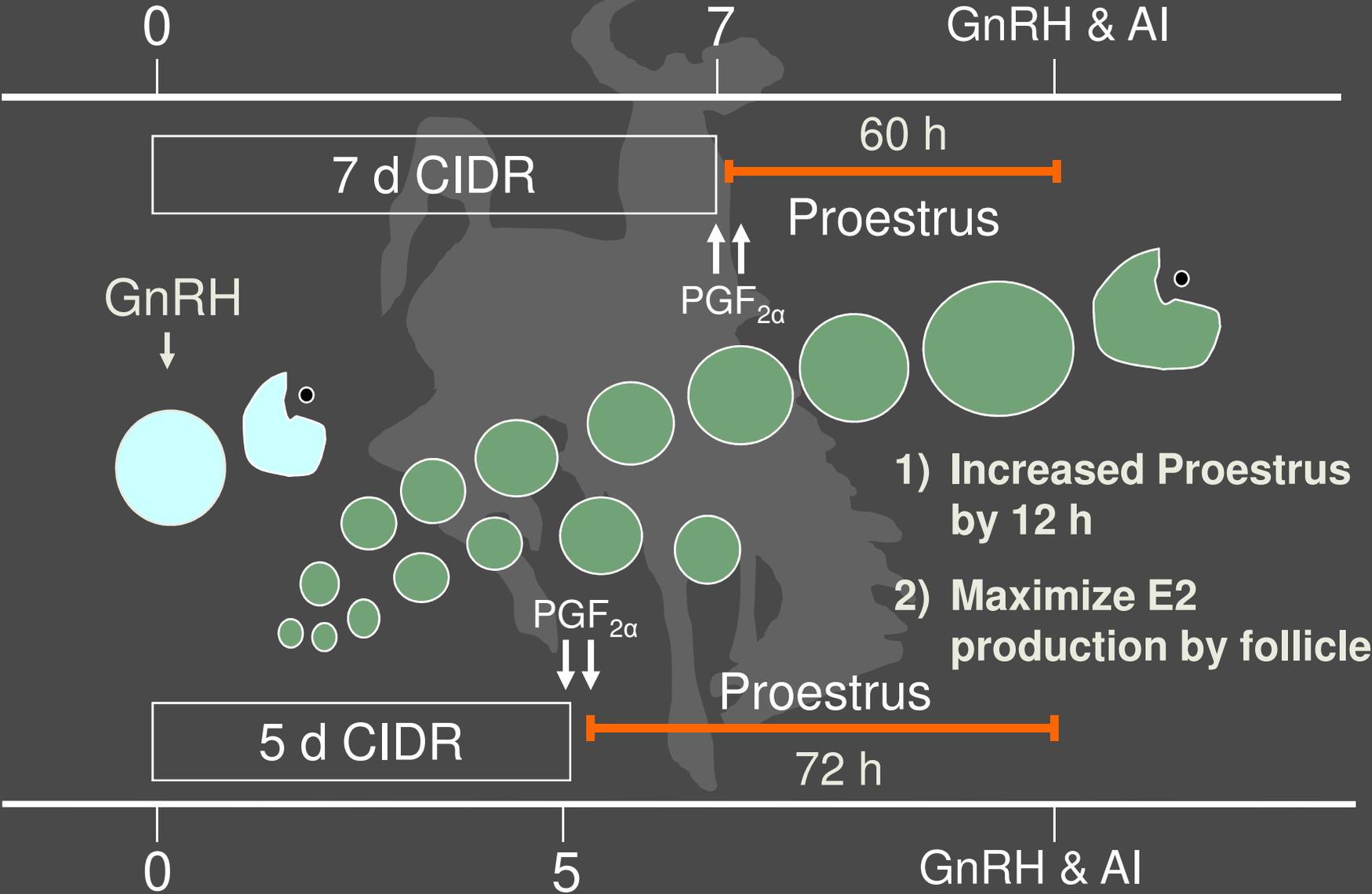
- An immature follicle that produces less estradiol results in reduced fertility



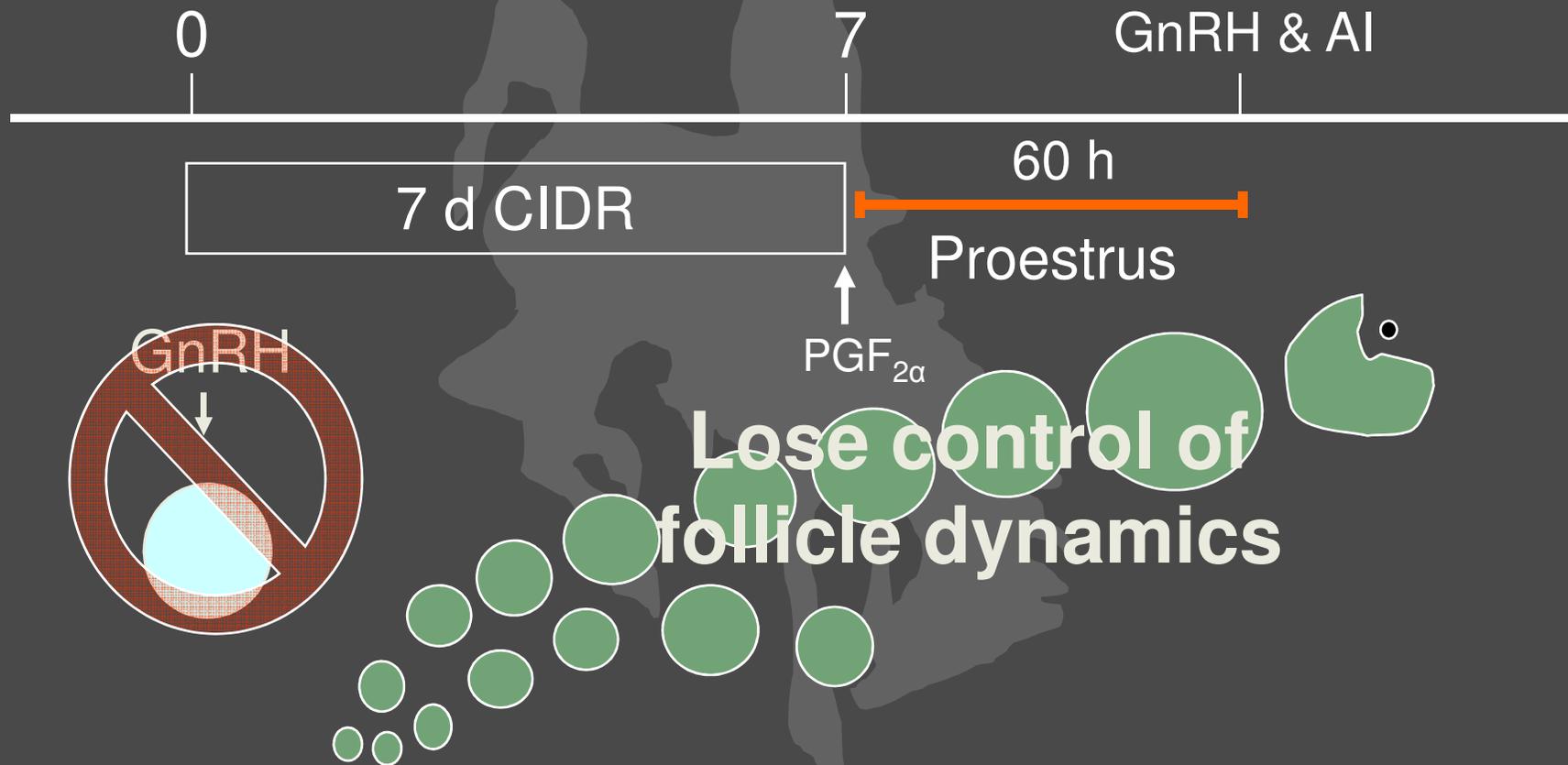
# Improving the CO-Synch + CIDR Program



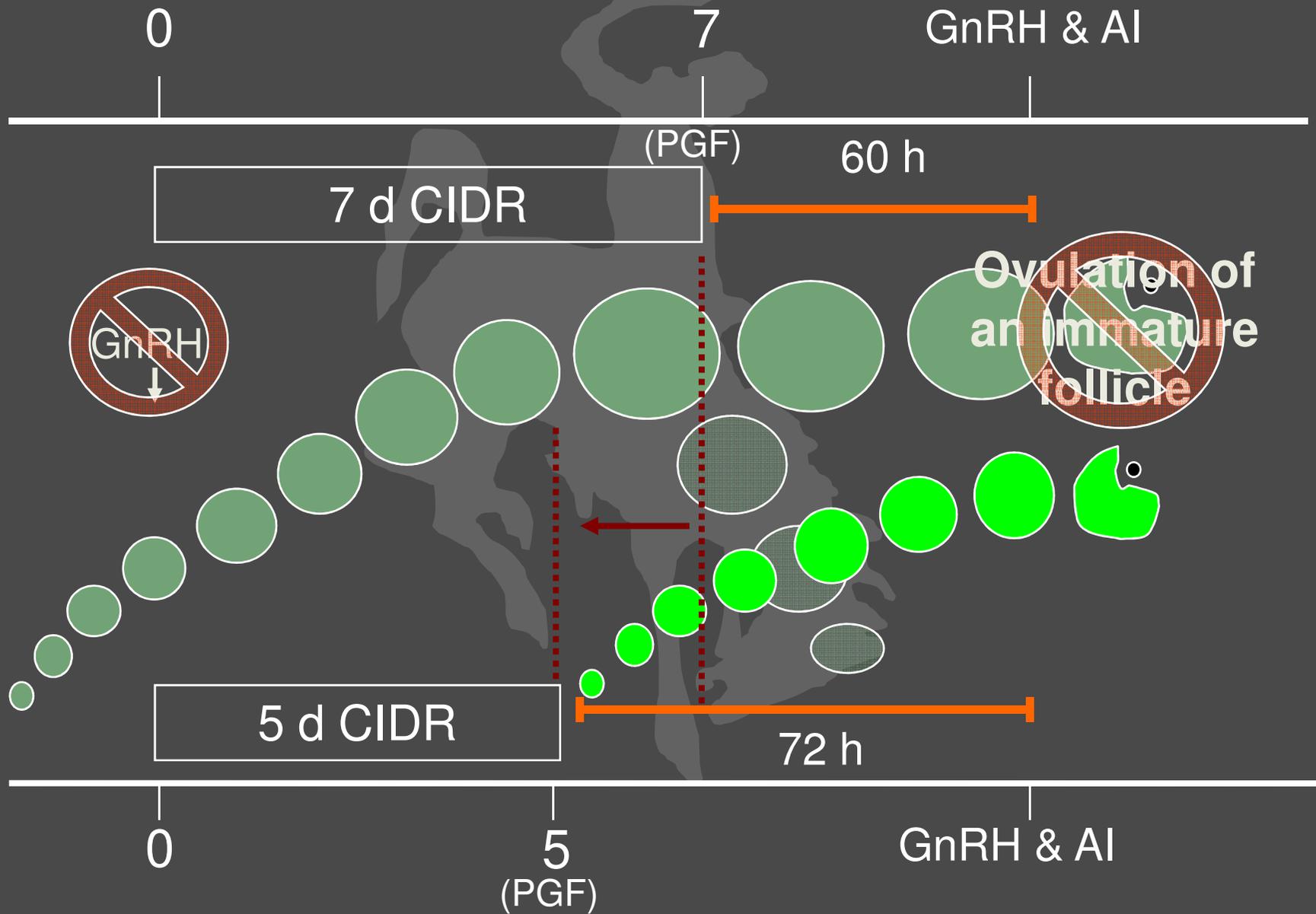
# Rationale for 5 d Program



# Problem with 7 d Program



# Improvements with the 5 d Program



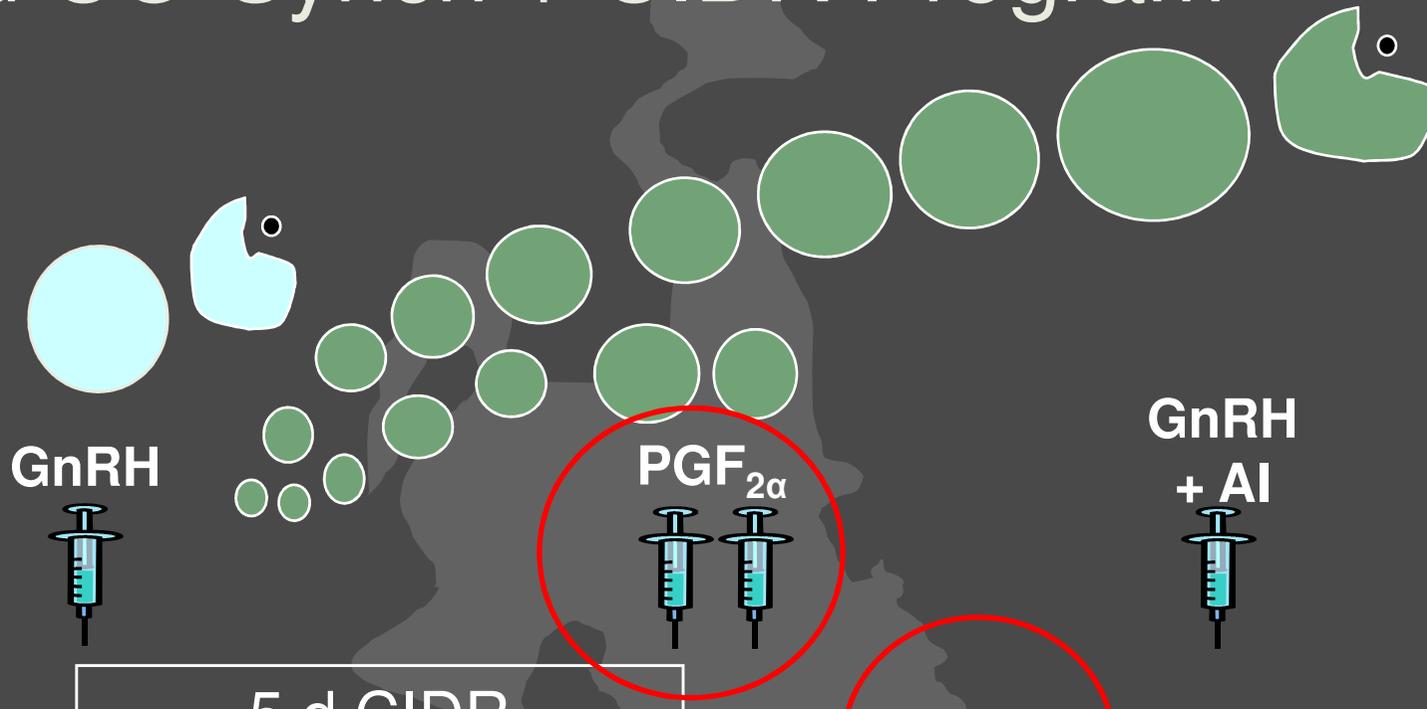
# Comparison

## Timed-AI Pregnancy Rate, % (n)

	7 d CIDR	5 d CIDR	
Mature Beef Cows			
2005	66.7 (111)	80.0 (105)*	↑ 13.3%
2006	56.2 (201)	65.3 (199)*	↑ 9.1%
Yearling Beef Heifers			
(Dr. John Hall, VPI&SU)			
2006	49.0 (204)	59.7 (201)*	↑ 10.7%

\* Within year; P < 0.05

# 5 d CO-Synch + CIDR Program



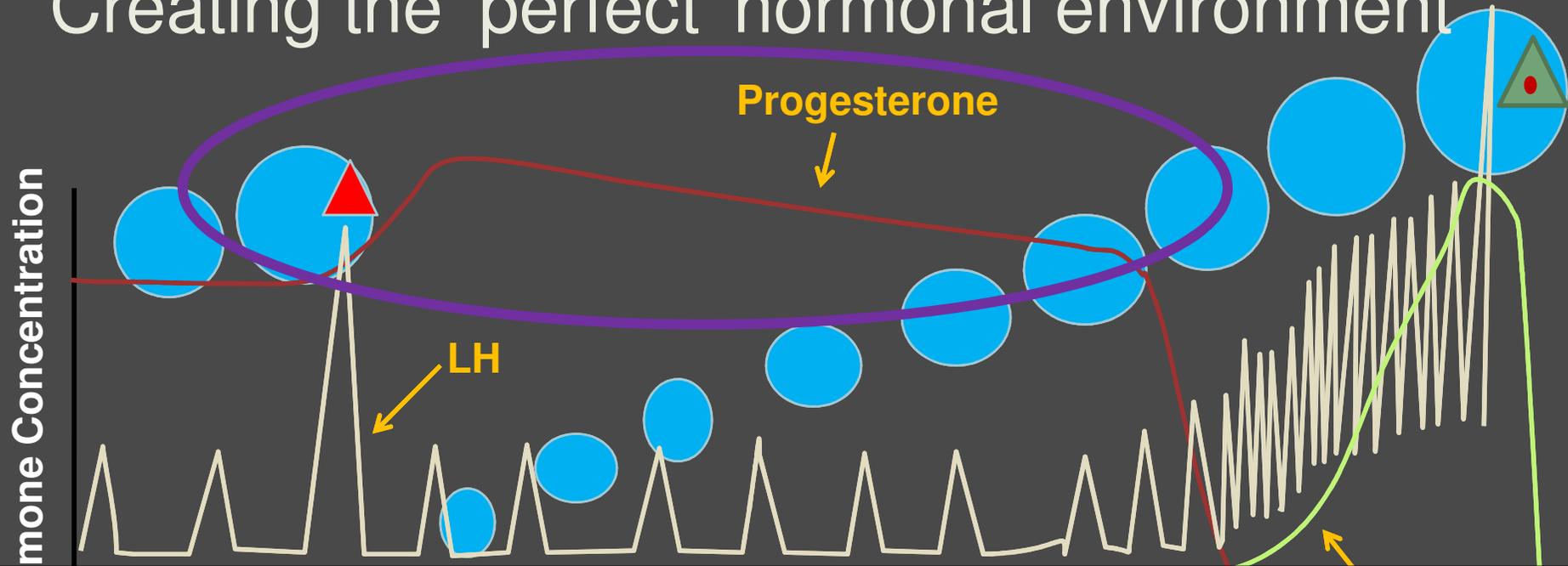
# cows	% Preg to Timed-AI	Reference
199	65	Bridges et al., 2007
128	69	Unpublished Results
282	70	Unpublished Results
105	80	Bridges et al., 2007
<b>Total</b>		
<b>714</b>	<b>70%</b>	



# 5 d CO-Synch + CIDR Program

- Advantages
  - Increased timed-AI pregnancy rates than 7 day program
  - Shortest program available
  - Induce estrous cycles in anestrus cows
  - Effective in cyclic and anestrus cows
  
- Disadvantages
  - Must give 2 injections of PGF
  - Increased cost of CIDR

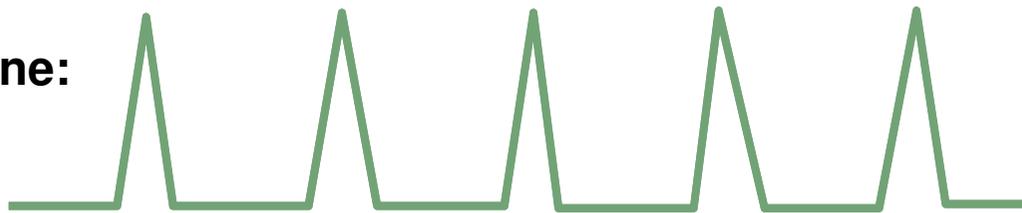
# Creating the 'perfect' hormonal environment



+ Luteinizing Hormone (LH) is the “driver” of follicle growth, estradiol synthesis, and oocyte maturation

+ Progesterone concentrations impact LH secretion

HIGH Progesterone:



LOW Progesterone:



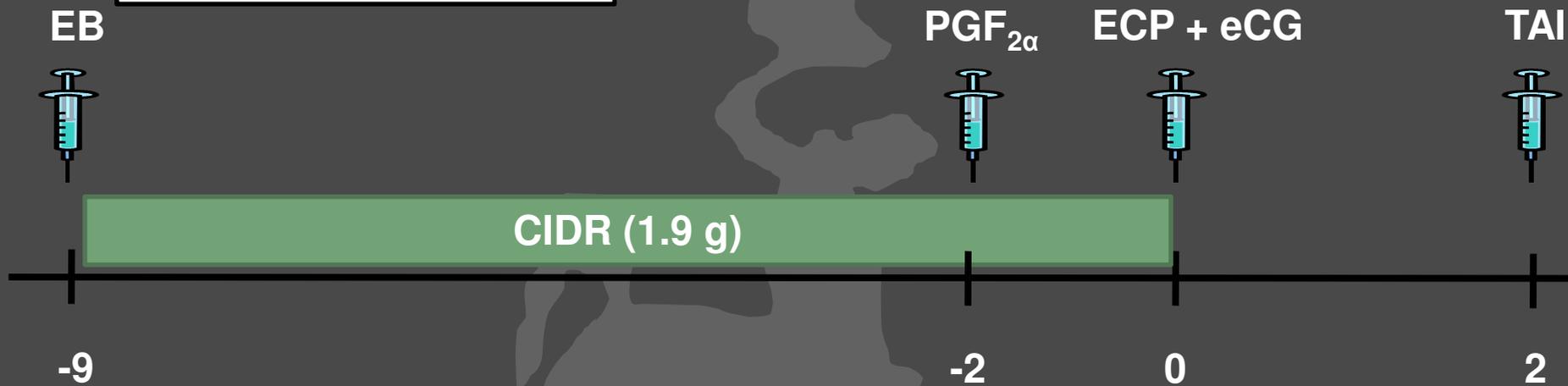
# Supporting evidence

- Dairy cows that have 3 follicular waves have greater fertility than those with 2 follicular waves (Townson et al., 2002)
  - 3<sup>rd</sup> wave grows in low progesterone environment
- In sheep, inhibiting LH during follicular maturation results in decreased estradiol concentrations and a reduction in fertilization rates and decrease in embryo development (Oussaid et al., 1999)
- Increased follicular fluid estradiol concentrations prior to ovulation improves oocyte maturation and competence (Driancourt et al., 1998; van de Leemput et al., 1998; Oussaid et al., 1999).



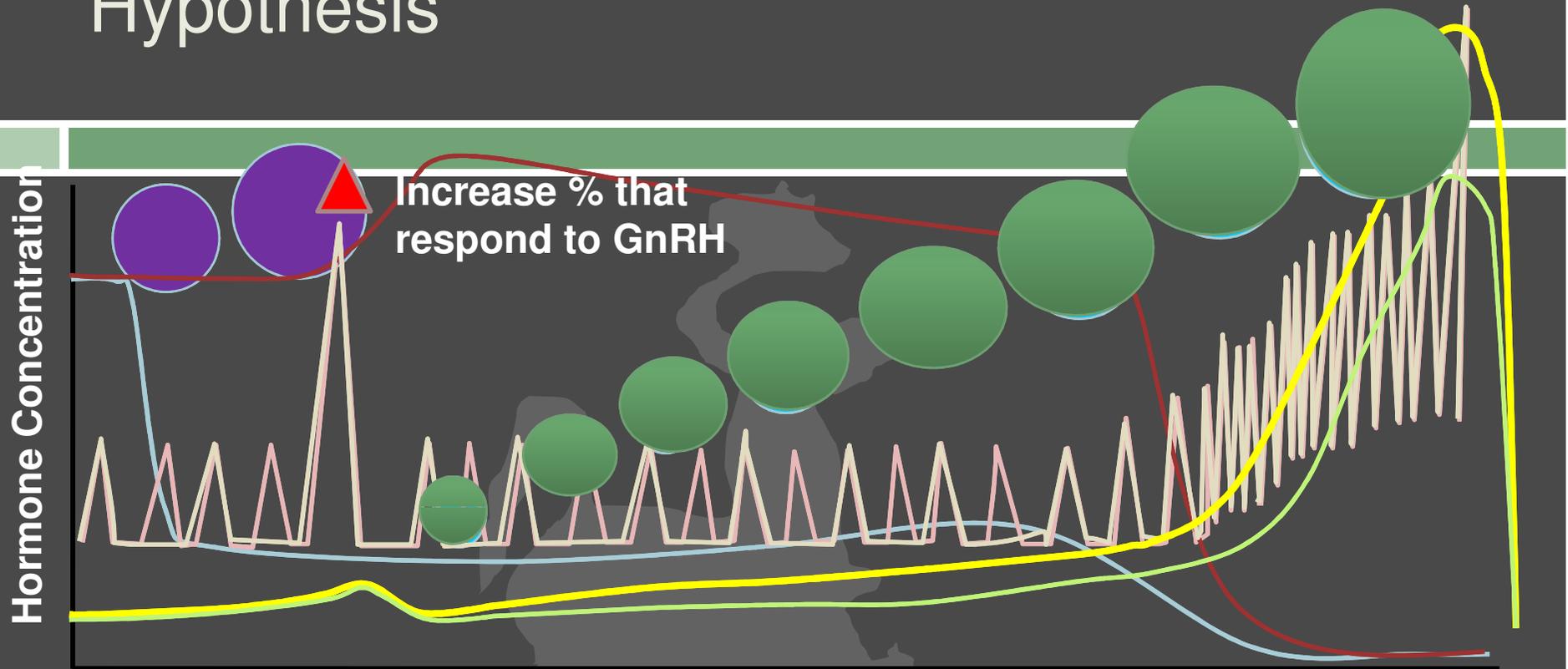
## Supporting evidence

J.L. Vasconcelos et al.



- Implementing methods to decrease circulating concentrations of progesterone and/or exogenously administering LH increases pregnancy rates in Nelore females

# Hypothesis



GnRH



5

CIDR

PGF<sub>2α</sub>



0 +12h

GnRH + TAI



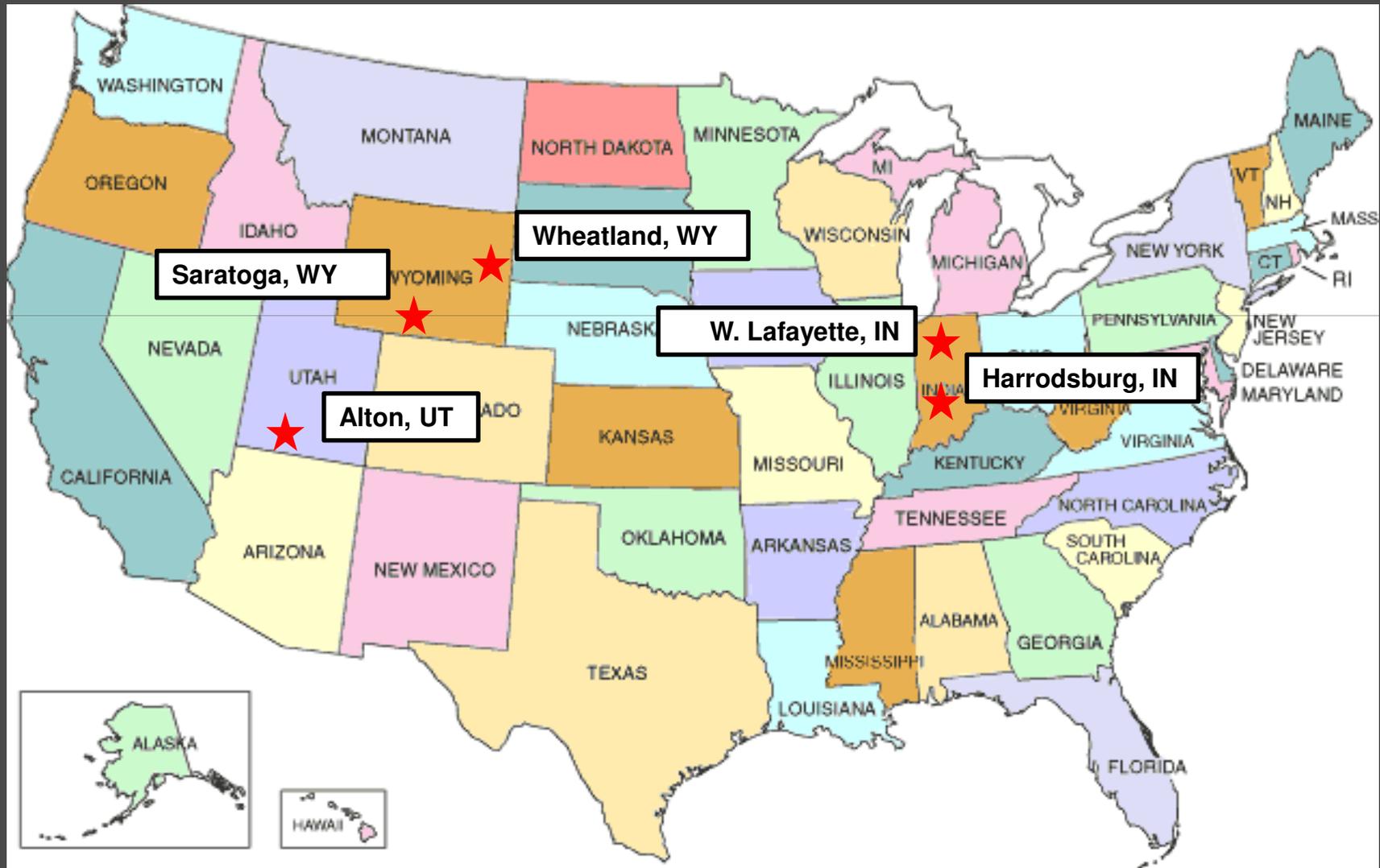
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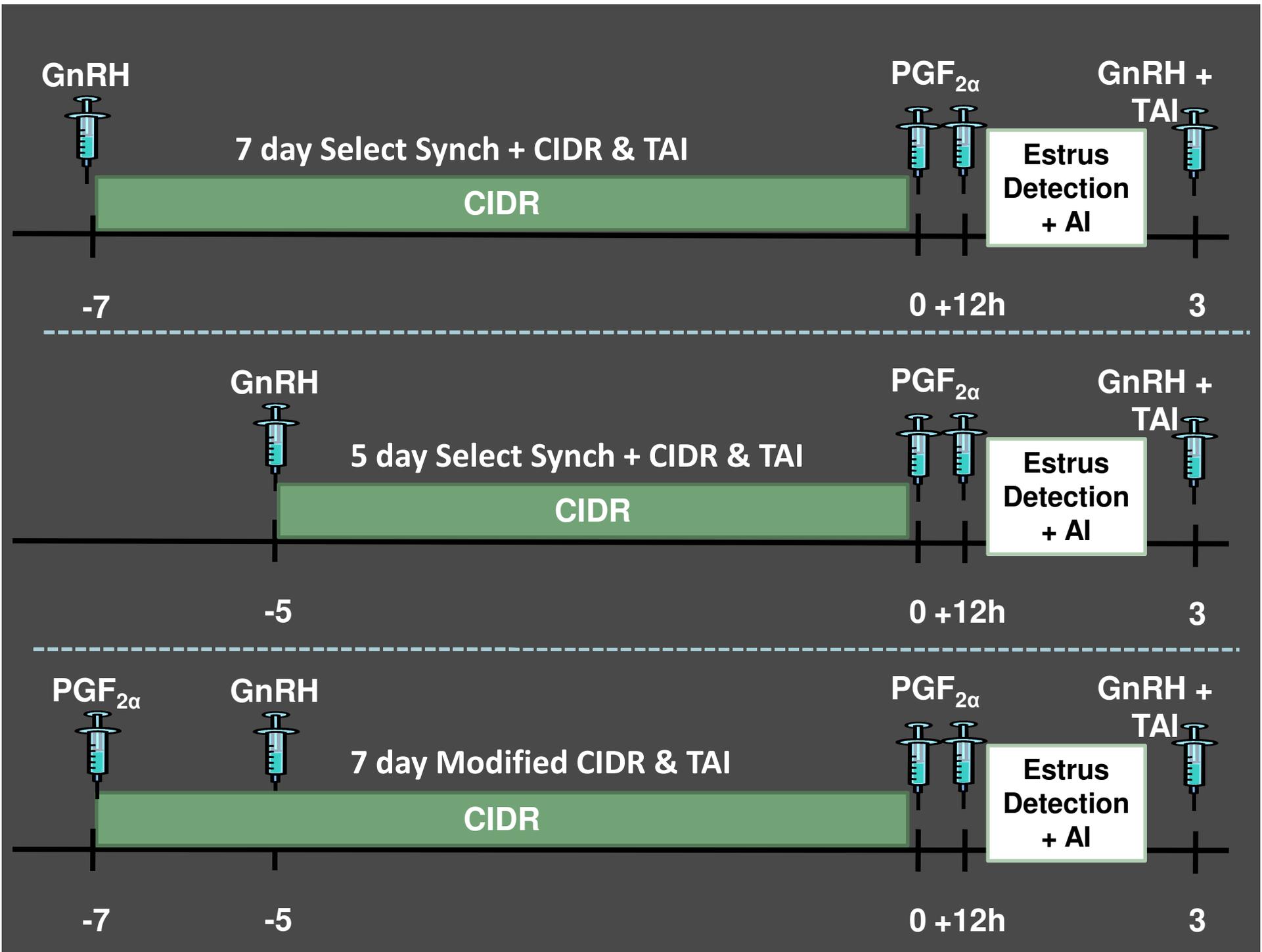
Estrus  
Detection  
+ AI

# Treatments and Herds

- **Virgin Replacement Beef Heifers**
  
- **Estrous Synchronization Treatments**
  - 5 d Select Synch + CIDR & TAI (5d; n = 366)
  - 7 d Select Synch + CIDR & TAI (7d; n = 298)
  - Modified 7 d CIDR & TAI (M; n = 373)
  
- **Locations**
  - ASREC, West Lafayette, IN ( n = 128)
  - Heaton Land & Livestock, Alton, UT (n = 218)
  - Silver Spur Ranch, Saratoga, WY (n = 229)
  - Turtle Creek Cattle Company, Harrodsburg, IN (n = 153)
  - Silver Spur Ranch, Wheatland, WY (n = 302)

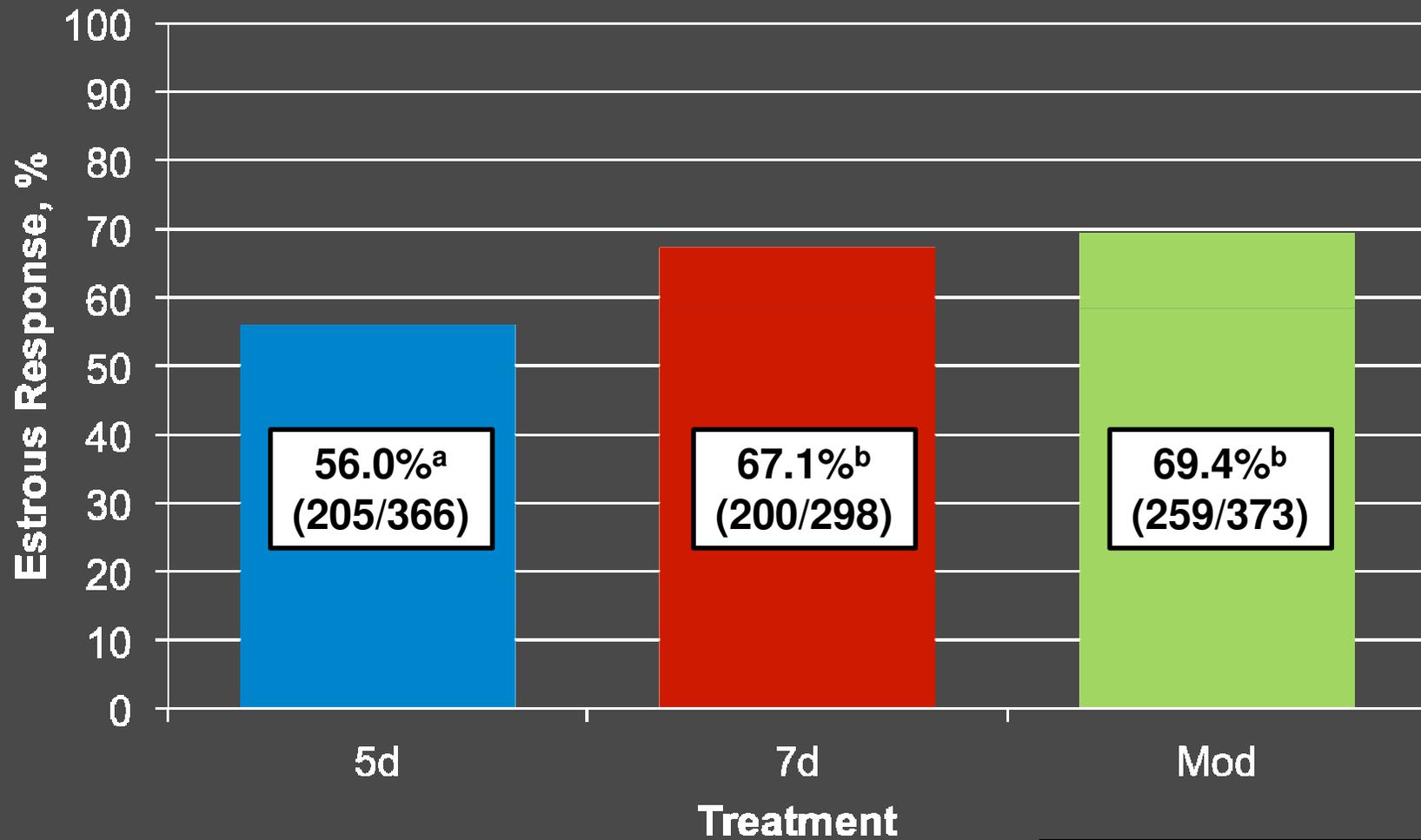
# Locations







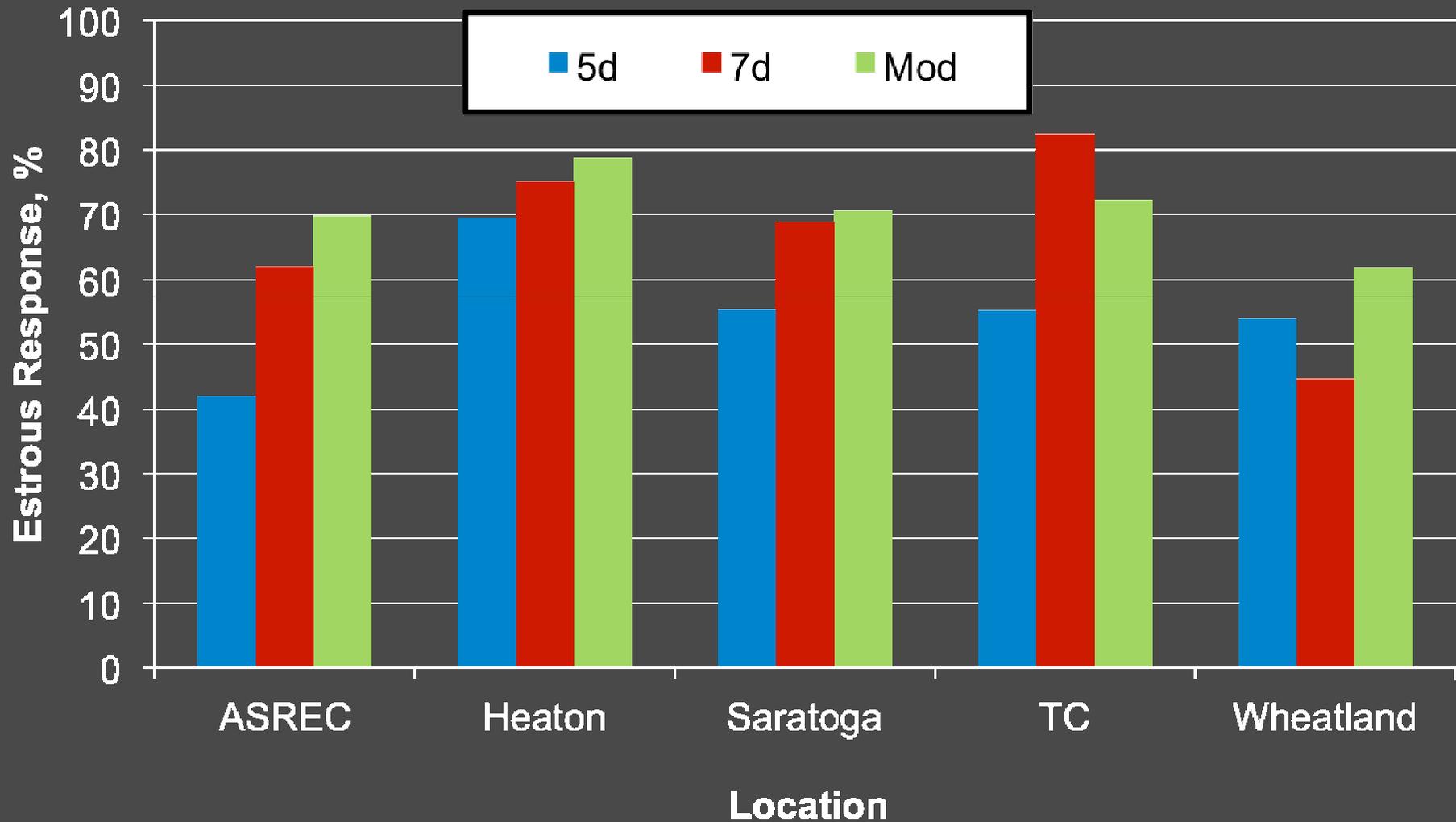
# Estrous Response



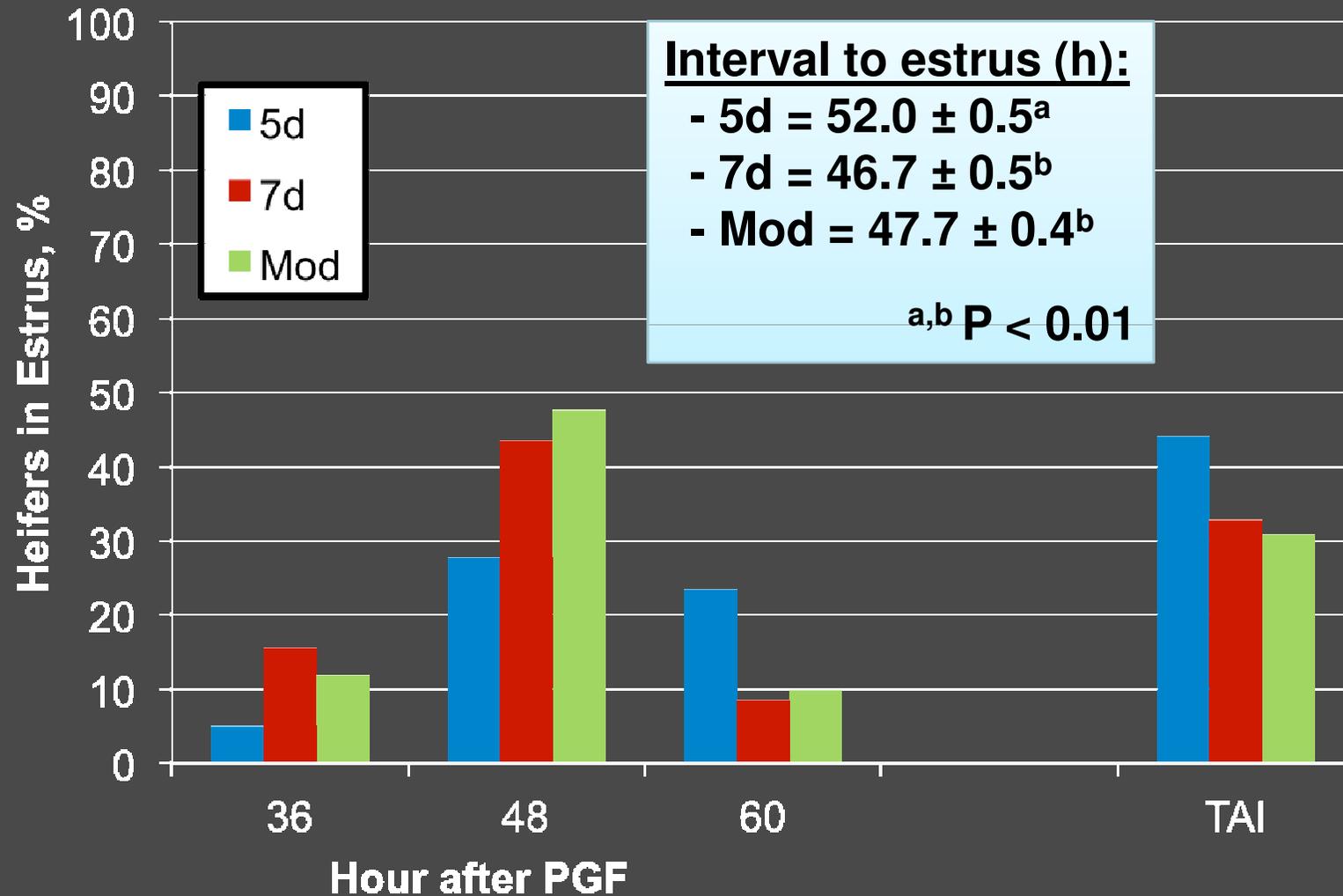
a,b  $P < 0.05$

# Estrous Response

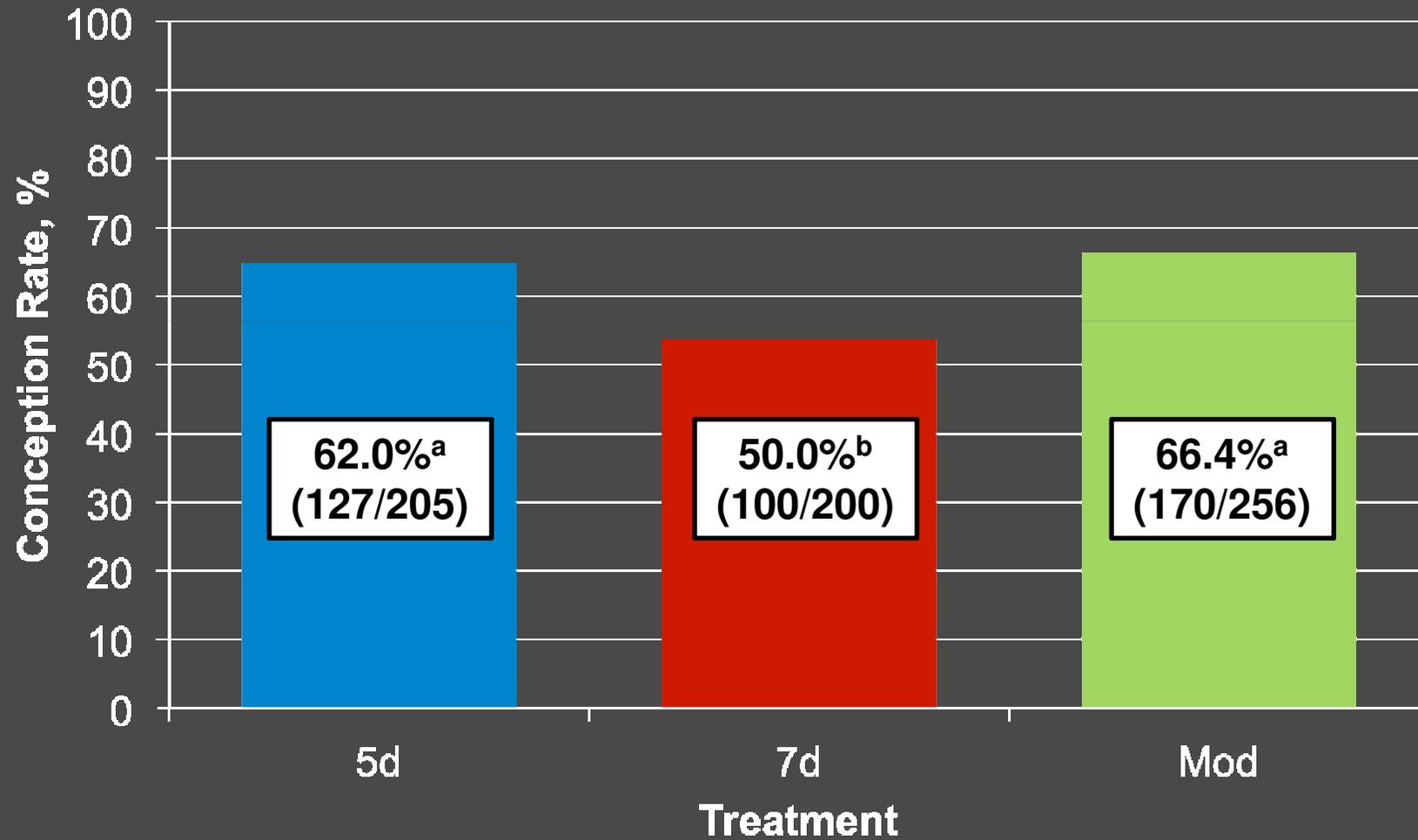
(Treatment by Location;  $P > 0.10$ )



# Estrous Distribution



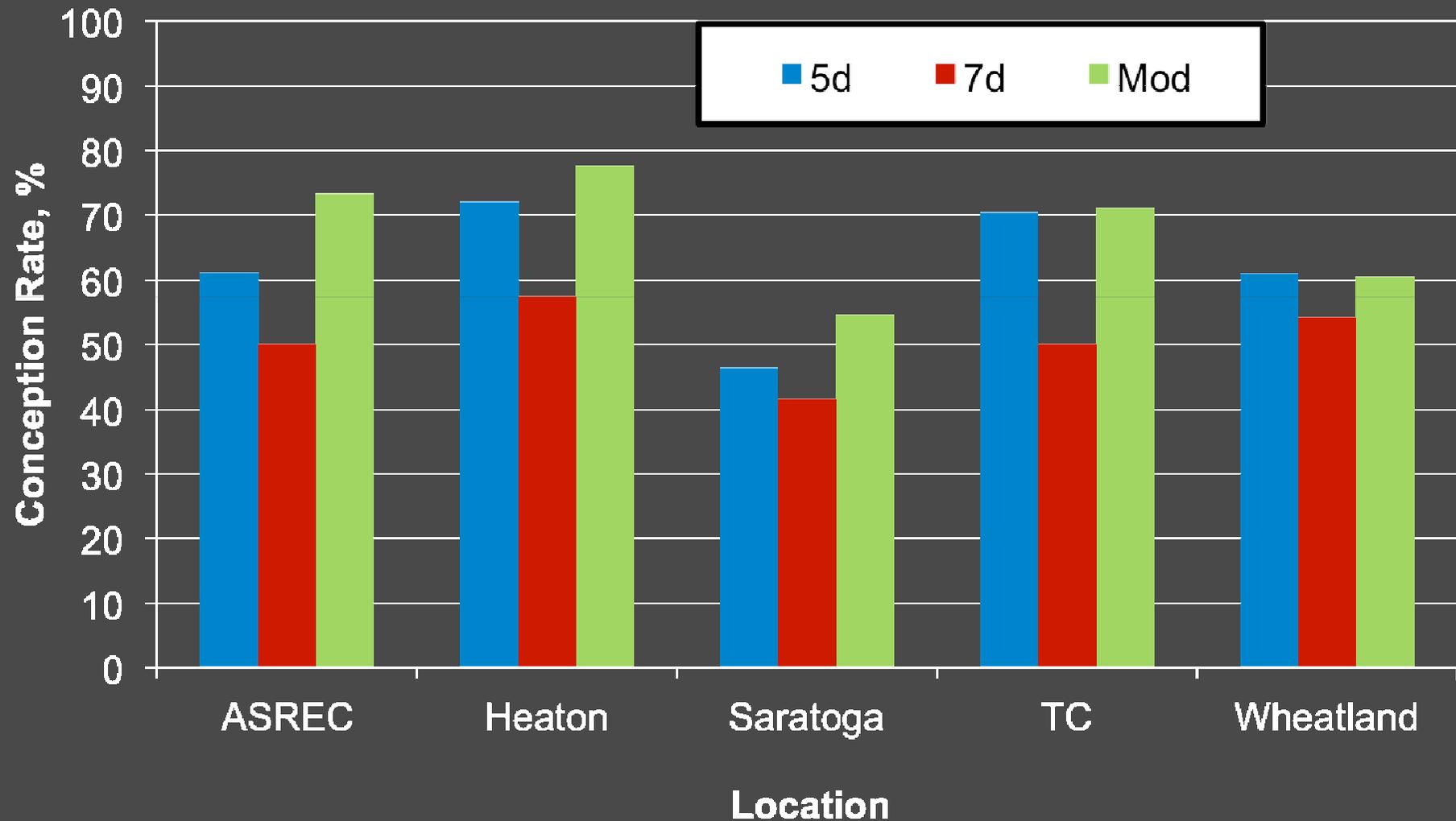
# Conception Rate of Heifers in Estrus



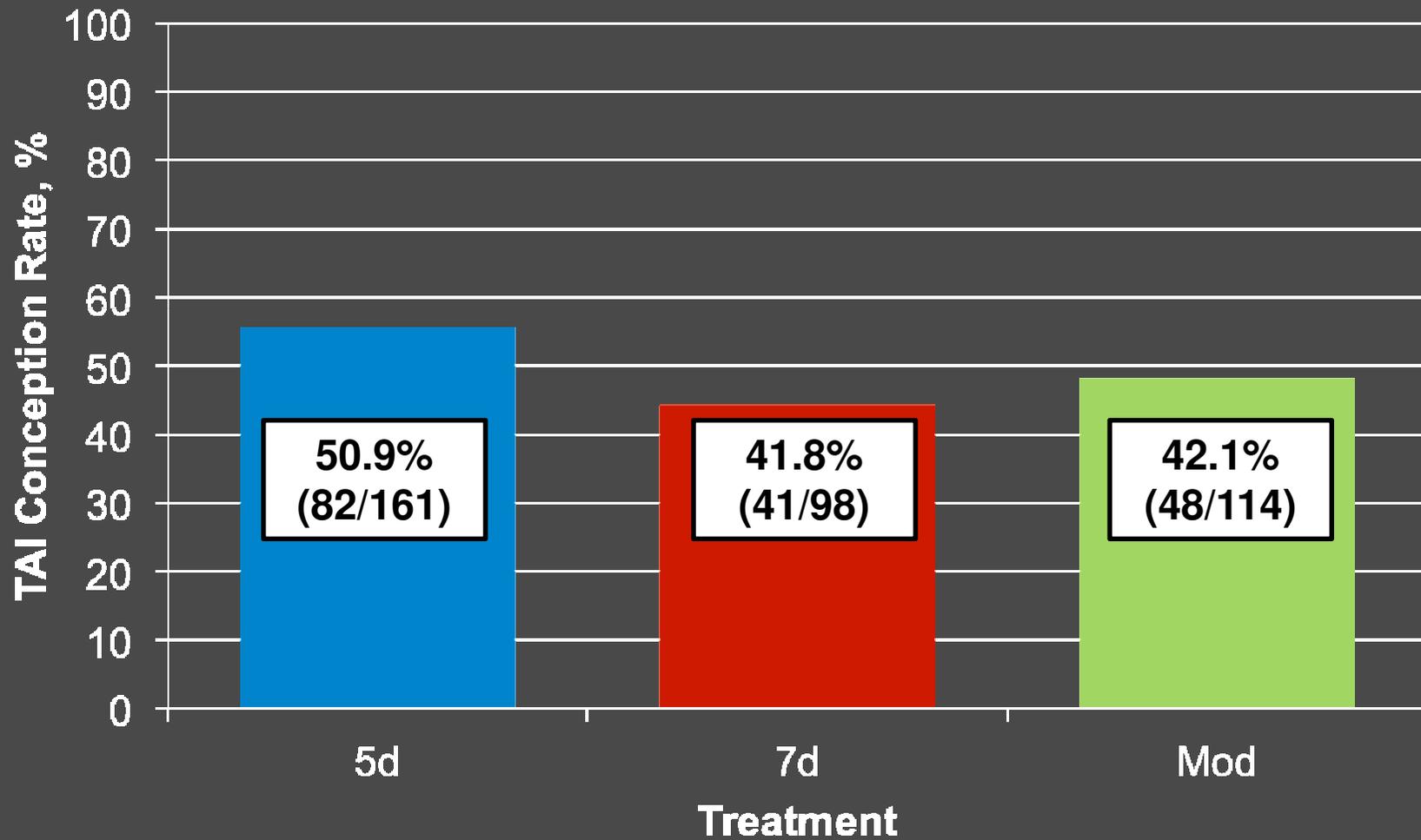
**a,b P < 0.01**

# Conception Rate of Heifers in Estrus

(Treatment by Location;  $P > 0.10$ )

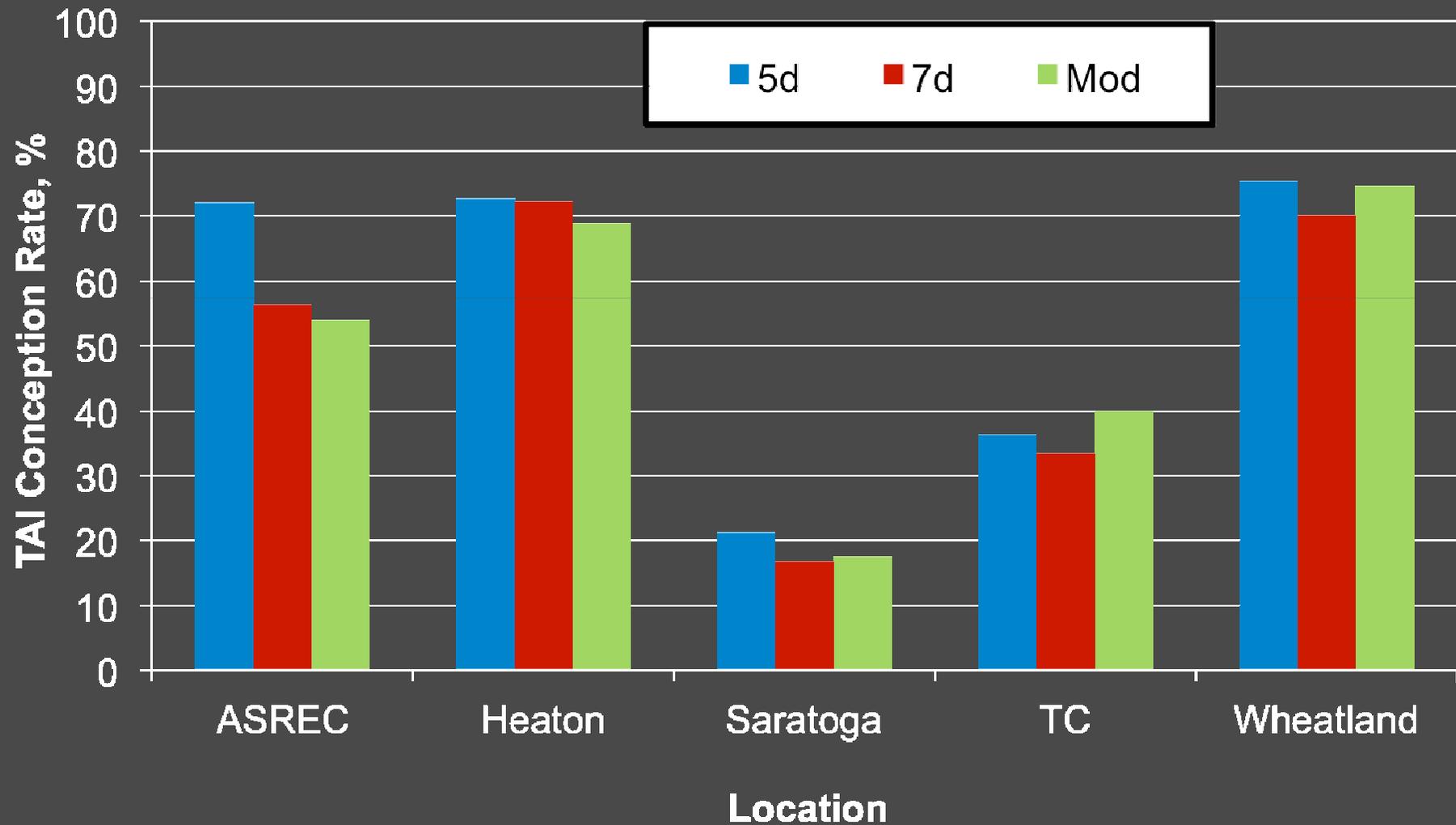


# Timed-AI Conception Rate



# Timed-AI Conception Rate

(Treatment by Location;  $P > 0.10$ )



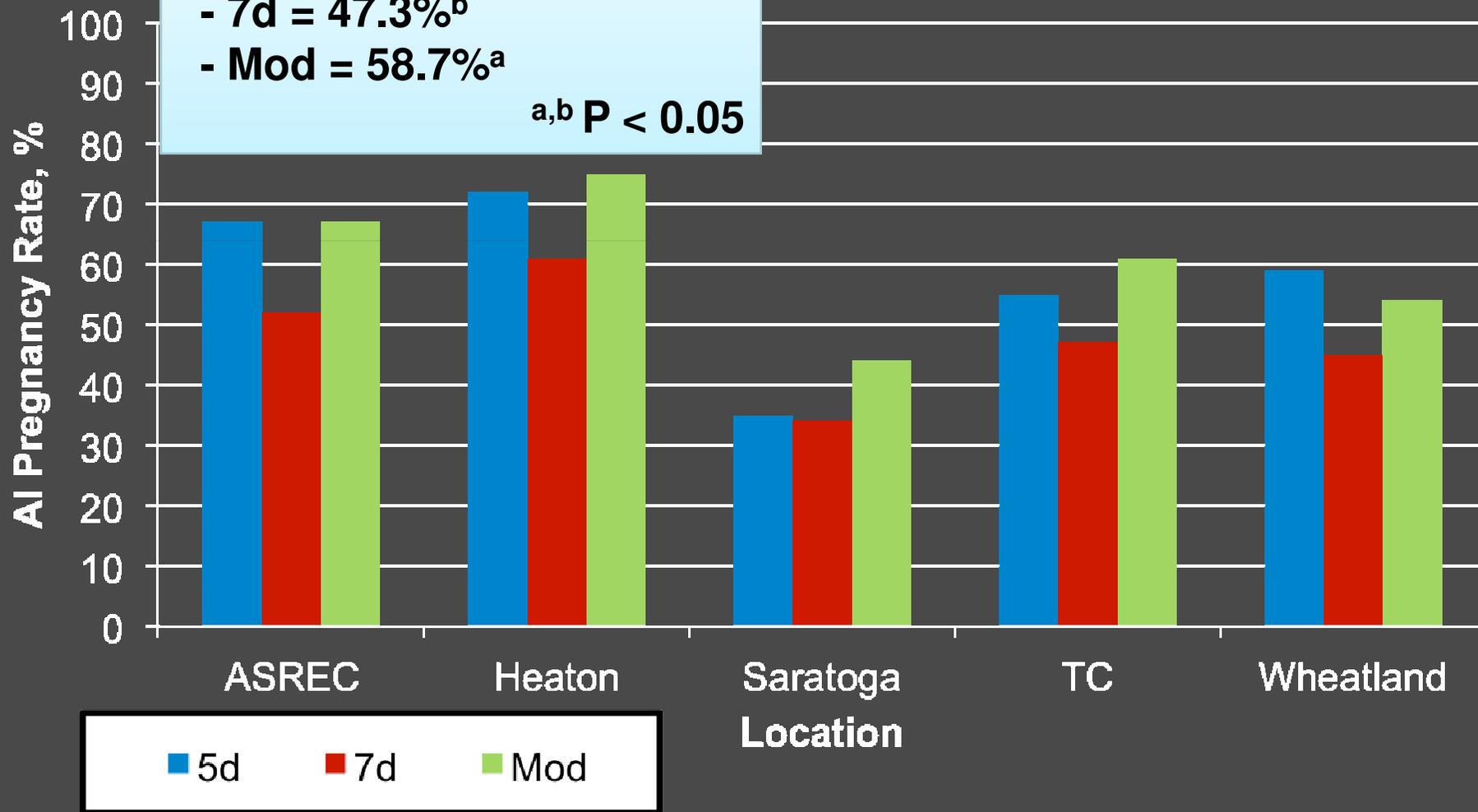
# Overall AI Pregnancy Rate

(Treatment by Location;  $P > 0.10$ )

## Overall AI Pregnancy Rate:

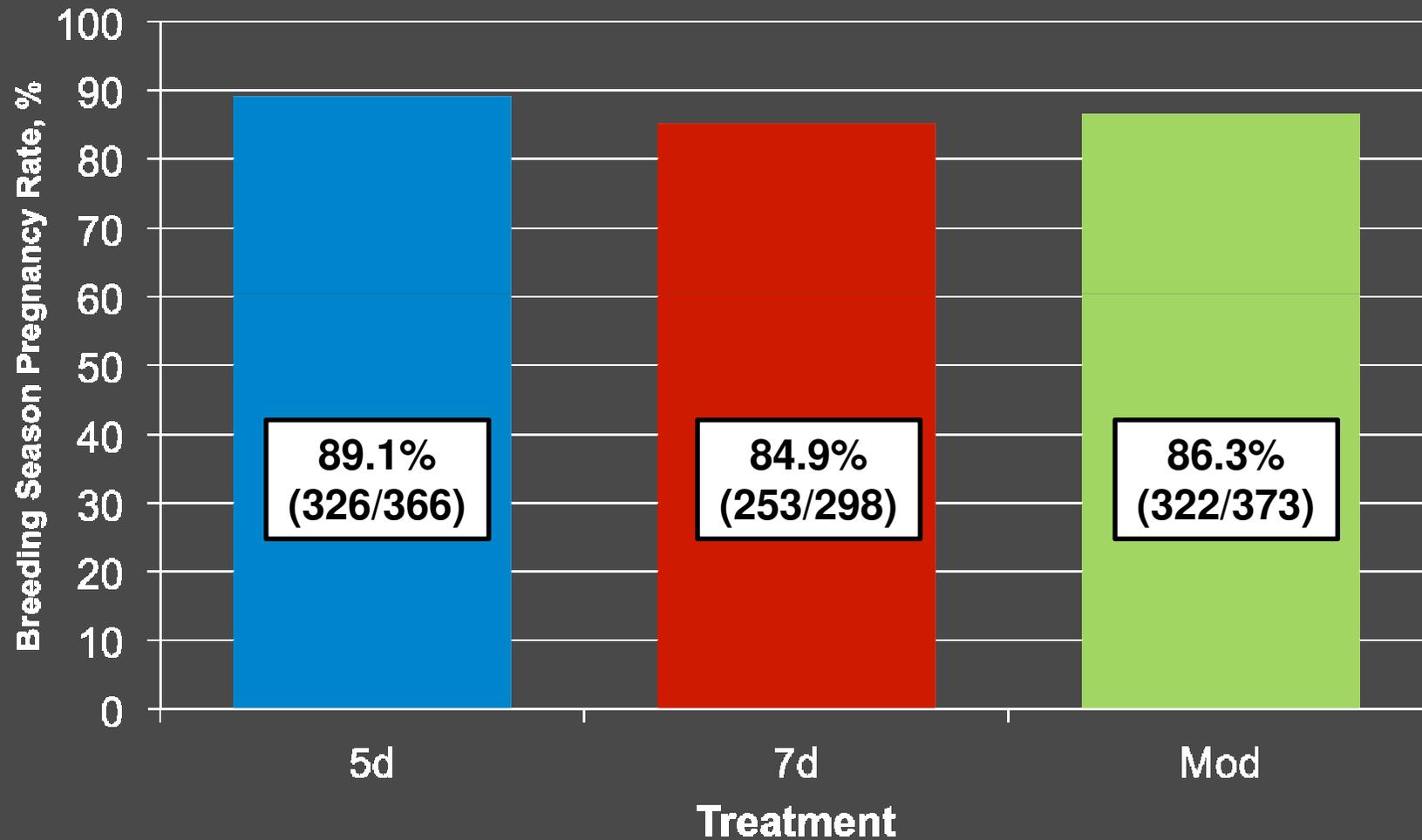
- 5d = 57.1%<sup>a</sup>
- 7d = 47.3%<sup>b</sup>
- Mod = 58.7%<sup>a</sup>

a,b  $P < 0.05$



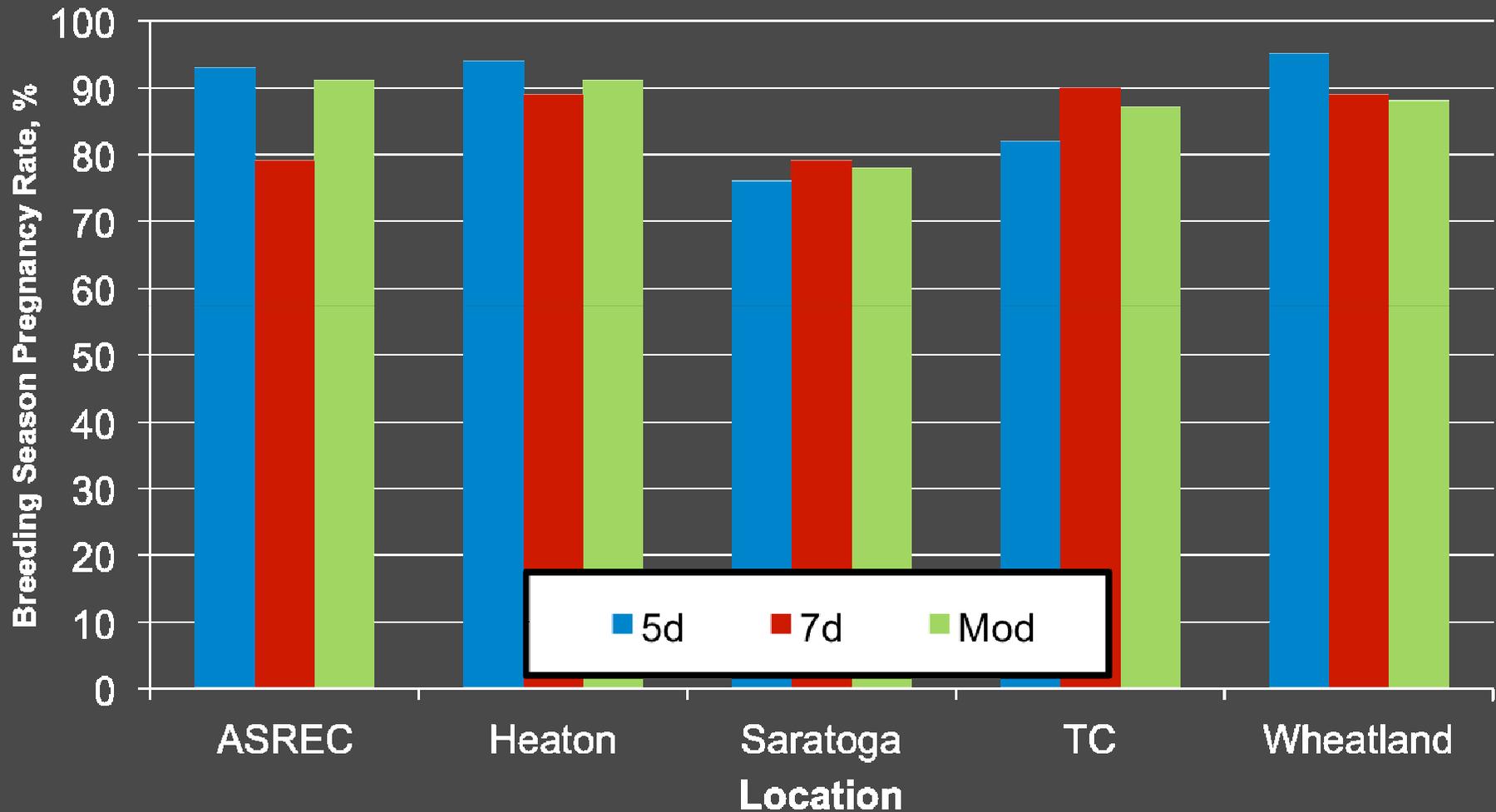


# Breeding Season Pregnancy Rate



# Breeding Season Pregnancy Rate

(Treatment by Location;  $P > 0.10$ )



# Thank you

**Scott Lake**  
**Dept. of Animal Science**  
**University of Wyoming**  
**scotlake@uwyo.edu**  
**307-766-3892 (office)**  
**307-460-8129 (cell)**



# Calving distribution

60 day Calving Season

Day 0

Day 21

Day 60



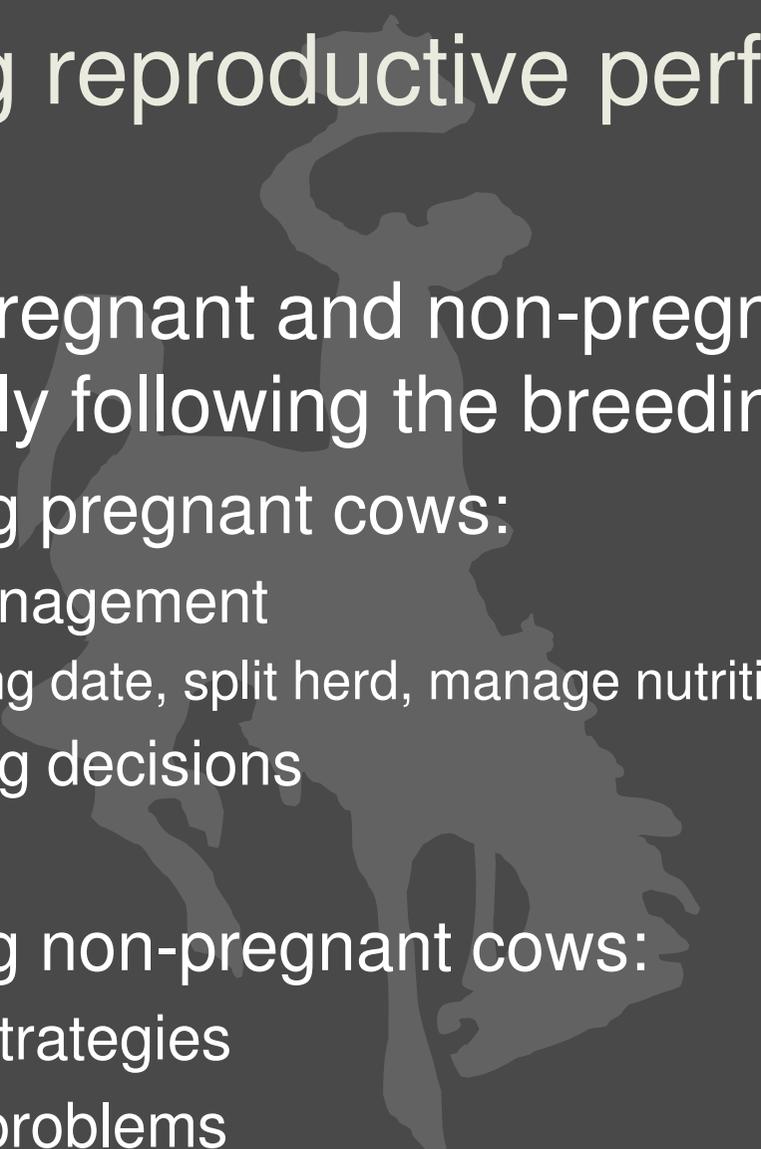
	Calf A (bull)	Calf B (bull)	Calf C (AI)	Calf D (bull)
<b>Birth Wt (lbs)</b>	90	90	90	90
<b>ADG (lbs/day)</b>	2.0	2.0	2.1	2.0
<b>Age at Weaning (days)</b>	225	165	225	204
<b>Weaning Wt (lbs)</b>	540	420	563	498
<b>Calf Value (\$/ lbs )</b>	1.10	1.18	1.10	1.15
<b>Total Value of Calf (\$)</b>	594	496	619	573
<b>Difference in Value (\$)</b>	- \$25	-\$123	-	-\$46/+\$77

# Calving distribution



	Calf A	Calf B
<b>Birth Wt (lbs)</b>	<b>90</b>	<b>90</b>
<b>ADG (lbs/day)</b>	<b>2.0</b>	<b>2.0</b>
<b>Age at Weaning (days)</b>	<b>225</b>	<b>165</b>
<b>Weaning Wt (lbs)</b>	<b>540</b>	<b>420</b>
<b>Calf Value (\$/ lbs )</b>	<b>1.10</b>	<b>1.18</b>
<b>Total Value of Calf (\$)</b>	<b>594</b>	<b>496</b>
<b>Value of 1 day older (\$)</b>	<b><u>\$1.63</u></b>	

# Evaluating reproductive performance

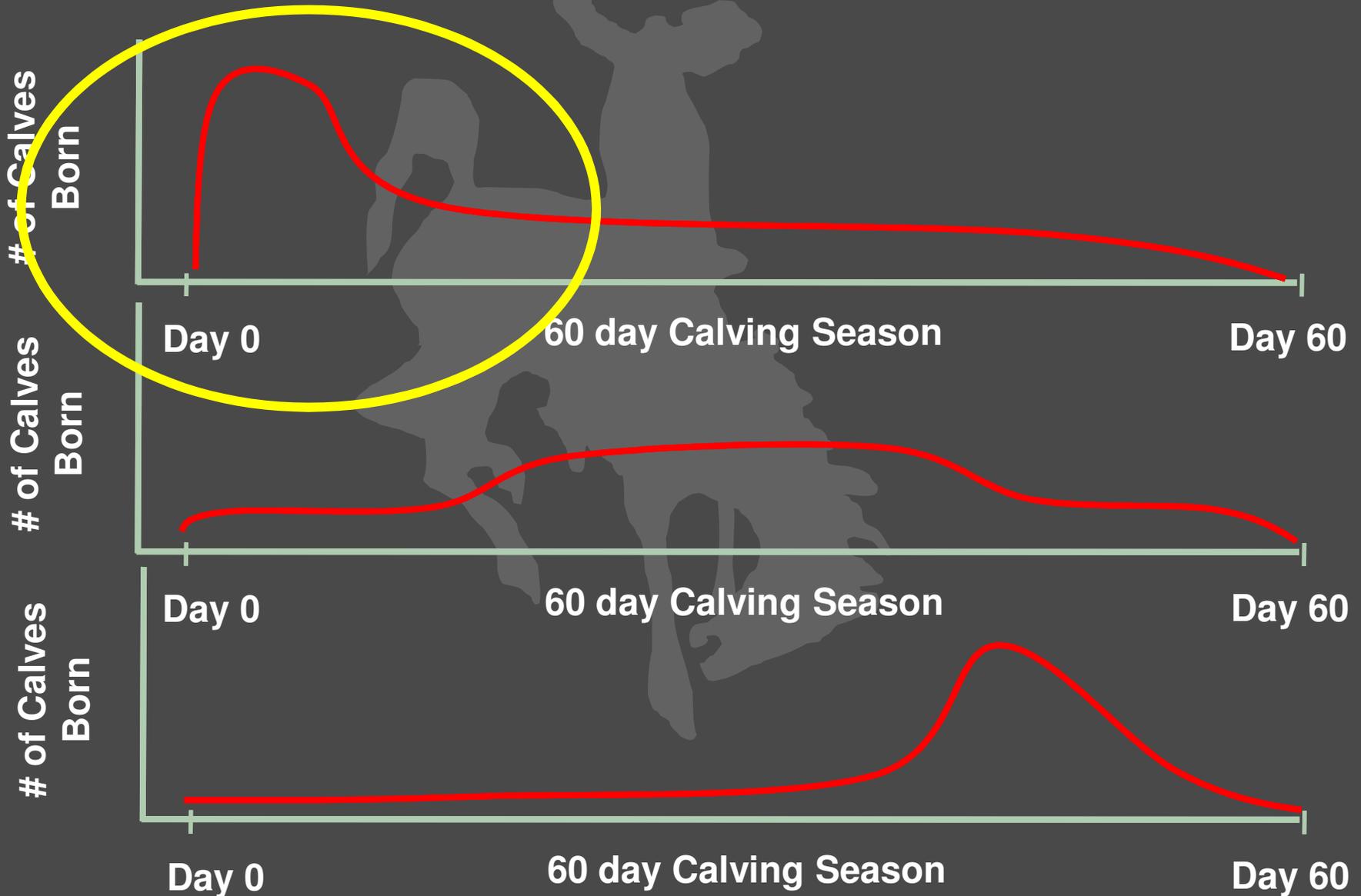


- Identify pregnant and non-pregnant cows immediately following the breeding season
  - Identifying pregnant cows:
    - Herd management
      - Calving date, split herd, manage nutrition
    - Marketing decisions
  - Identifying non-pregnant cows:
    - Culling strategies
    - Fertility problems
      - Early identified, the earlier can be corrected

# Cost of feeding an open cow

- ***A non-pregnant cow is a non-productive cow!***
- 55 to 70% of the cost of keeping an open cow is related to nutritional inputs
- Given the current cost of production, maintaining a non-pregnant cow can cost >\$200
- Identifying non-pregnant cows early following breeding:
  - Reduces costs
  - Assists in identifying other potential problems

# Calving distribution



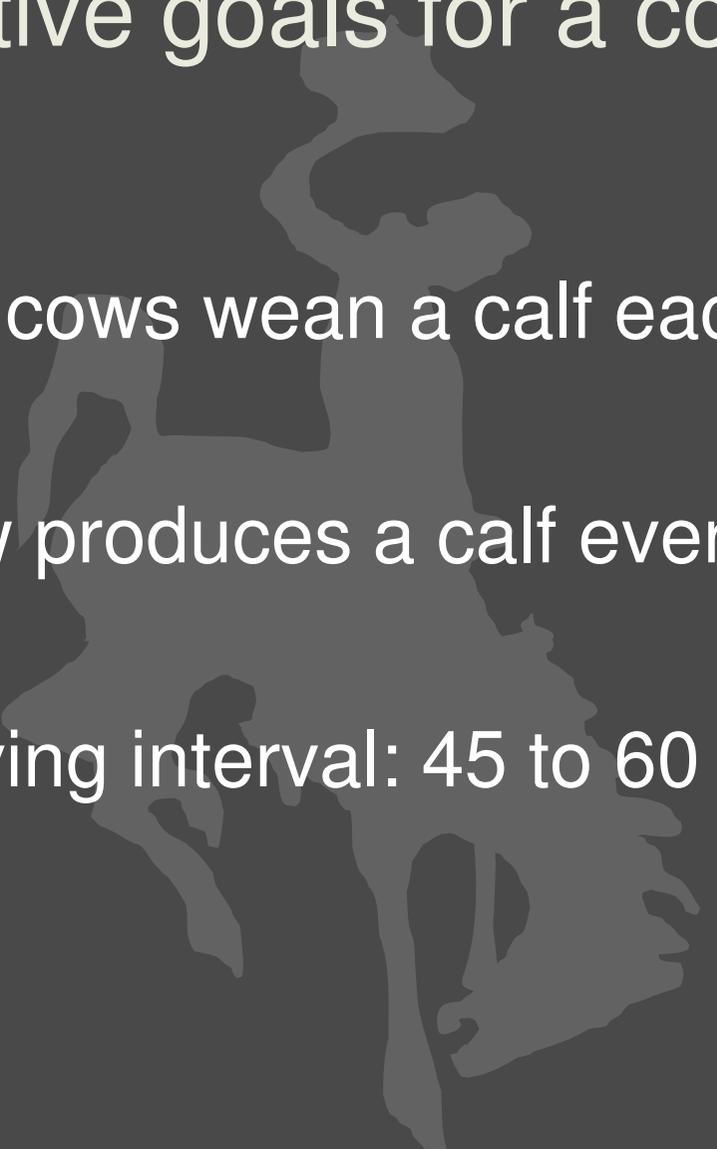


# Measuring your reproductive efficiency

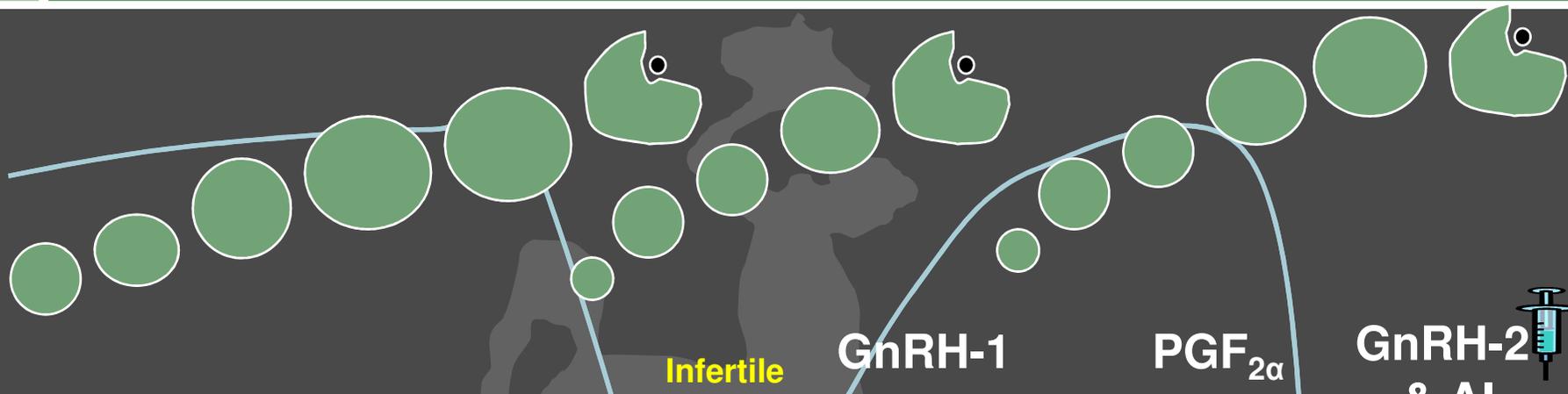
- % of cows that weaned a calf; goal >90%
- Calving interval
  - Average interval between calves in herd



# Reproductive goals for a cow/calf producer

1. > 90% of cows wean a calf each year
  2. Each cow produces a calf every 365 days
  3. Tight calving interval: 45 to 60 days
- 
- A faint, light-colored silhouette of a cow and a calf is visible in the background of the slide. The cow is standing and facing right, with the calf positioned slightly behind and to the right of the cow's midsection.

# MGA-Select Program

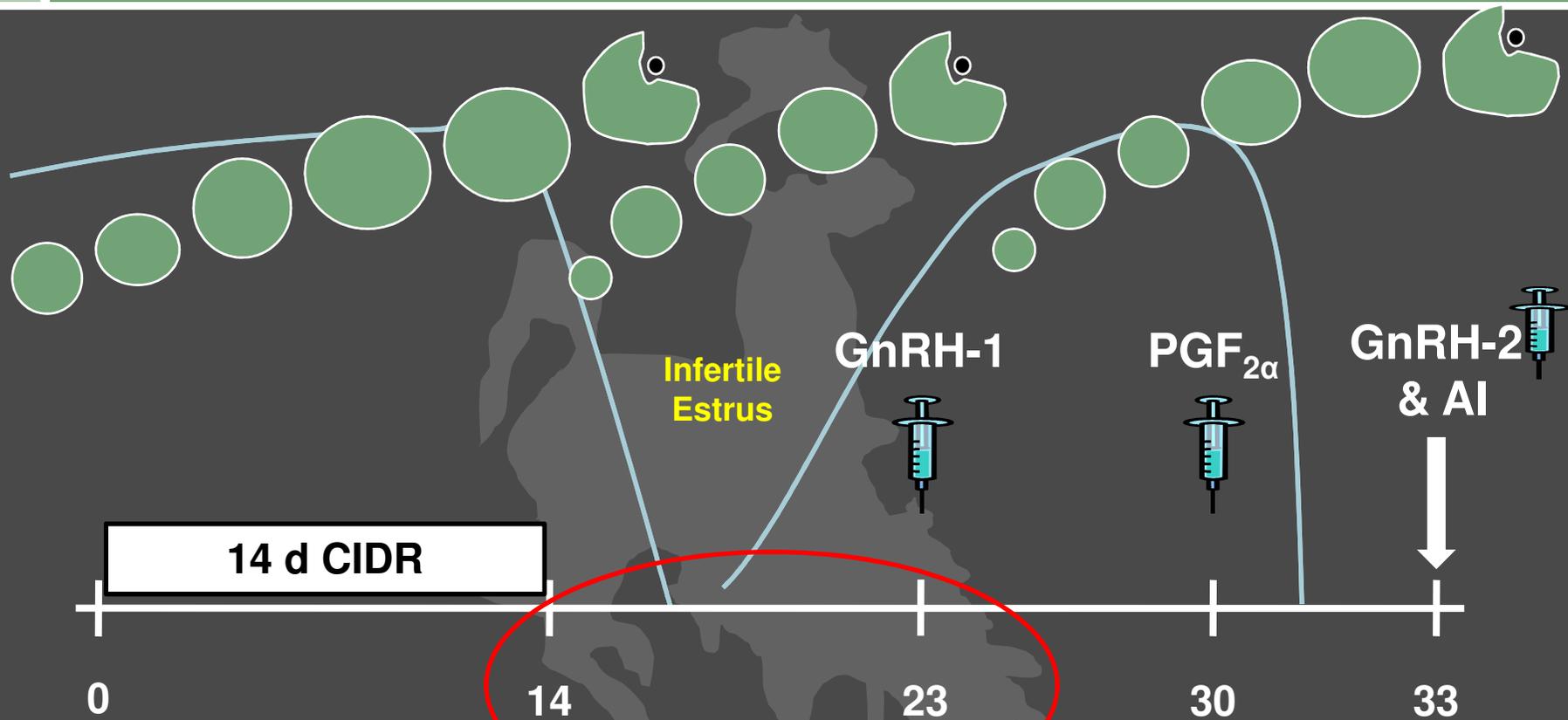


# cows	% Preg to Timed-AI	Reference
327	61	Schafer et al., 2007
115	61	Perry et al., 2002
213	67	Bader et al., 2005
108	69	Stegner et al., 2004
<b>Total</b>		
<b>763</b>	<b>64%</b>	

0

36

# CIDR-Select Program



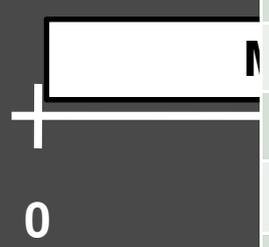
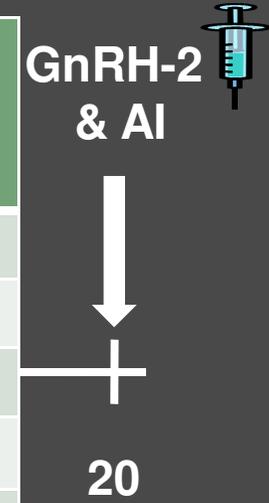
# MGA-Select & CIDR-Select Programs

- Advantages
  - Increased timed-AI pregnancy rates than 7 day program
  - Induce estrous cycles in anestrus cows
  - Effective in cyclic and anestrus cows
  
- Disadvantages
  - Duration of program may inhibit use
  - Feeding MGA-proper dosage each day
  - Handle animals 5 times (CIDR-Select)
  - Increased cost of CIDR

# 7-11 Synch Program



# cows		% Preg to Timed-AI	Reference
60	122	59	Kojima et al., 2003a
60	209	61	Bader et al., 2005
60	103	63	Kojima et al., 2003b
<b>Total</b>			
	<b>434</b>	<b>61%</b>	



# 7-11 Synch Program

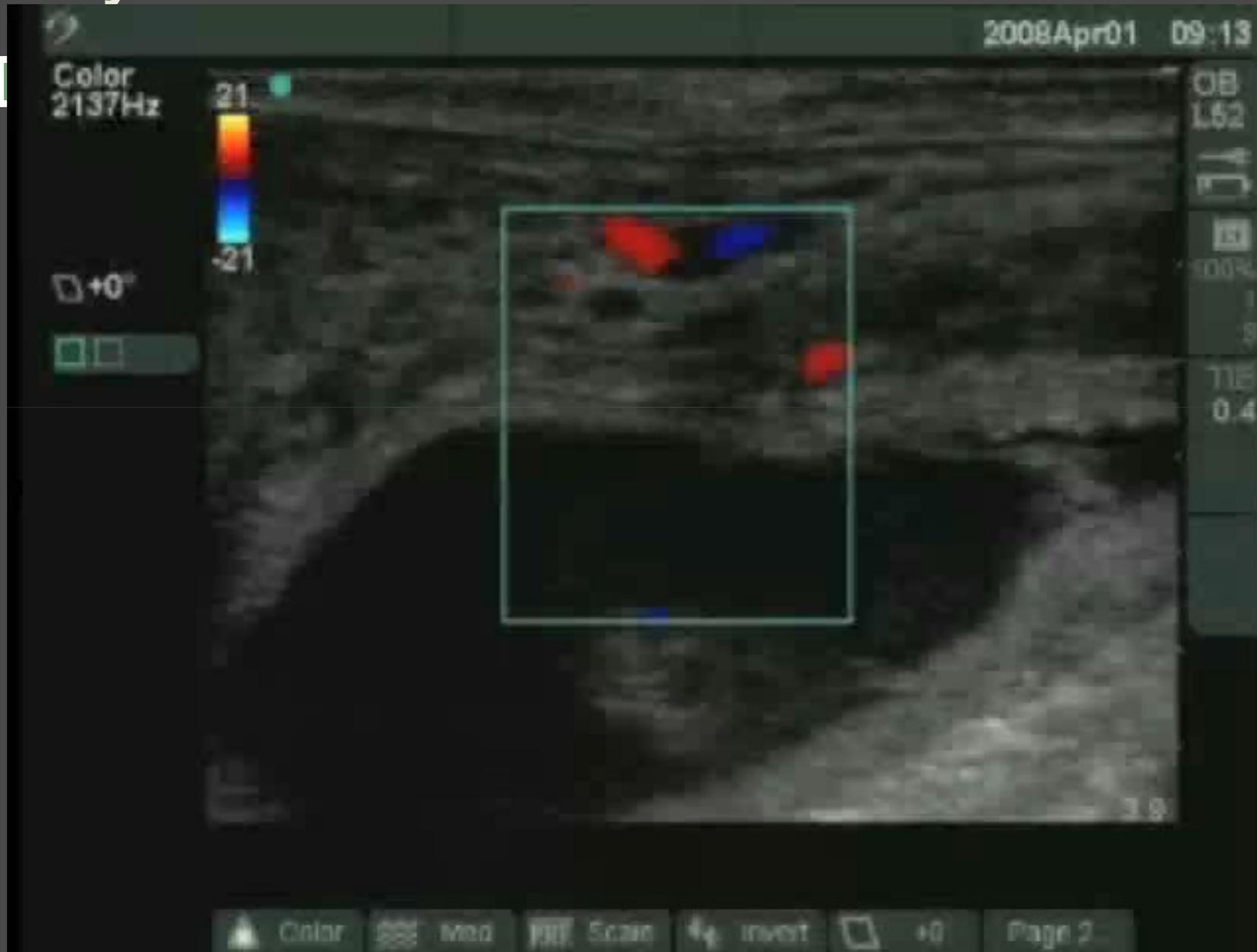
- Advantages
  - Increased timed-AI pregnancy rates than 7 day program
  - Induce estrous cycles in anestrus cows
  - Effective in cyclic and anestrus cows
  
- Disadvantages
  - Duration of program may inhibit use
  - Feeding MGA-proper dosage each day

# So, which one is right for you??

- No single program is perfect for every operations
- Must balance labor, cow status, costs, and benefits of AI when making a decision
- Compliance is key
- Have realistic expectations

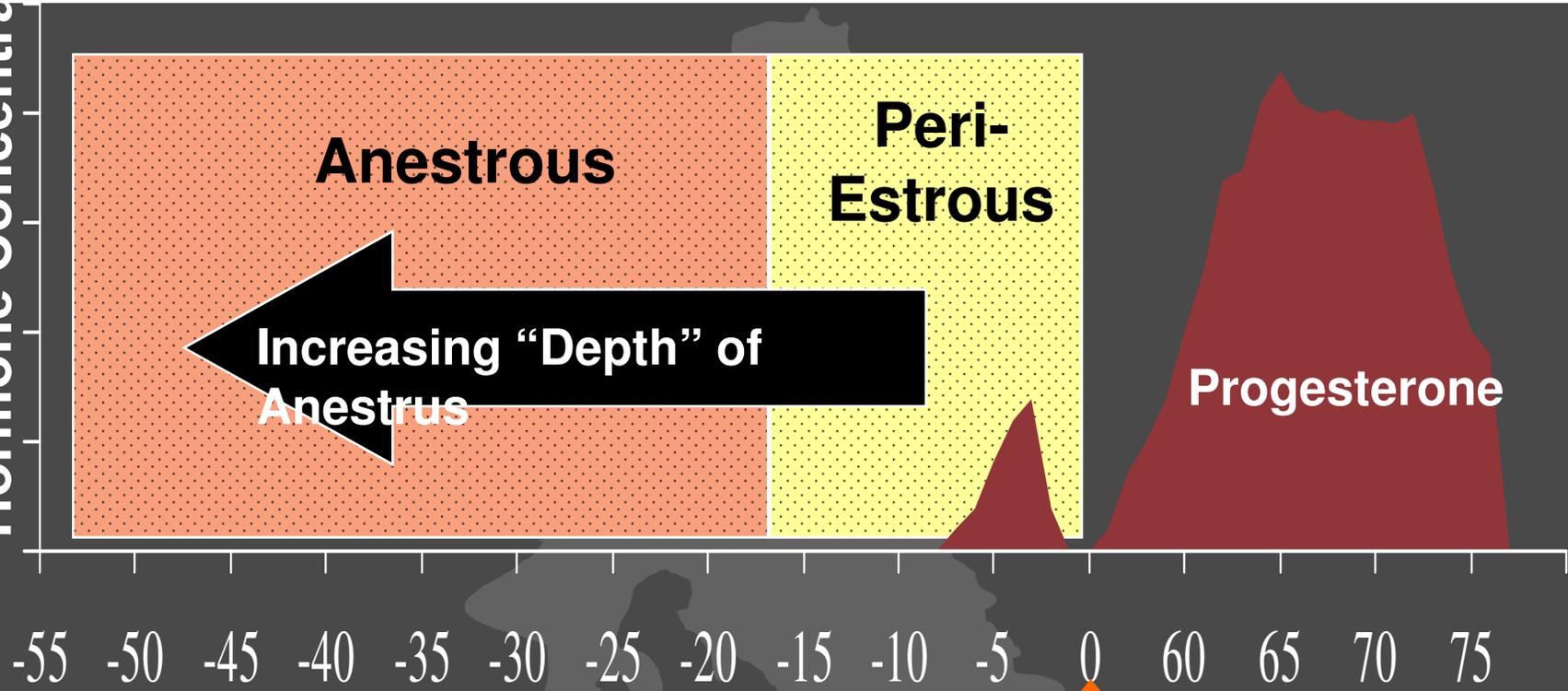


# Day 41 – Fetal Heart Blood Flow



# “Depth” of Postpartum Anestrus in Beef Cows

Hormone Concentration



Days Relative to First Estrus

First Estrus